



AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement (65)

JANUARY 1976

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement (65)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in December 1975 in

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 238 reports, journal articles, and other documents originally announced in December 1975 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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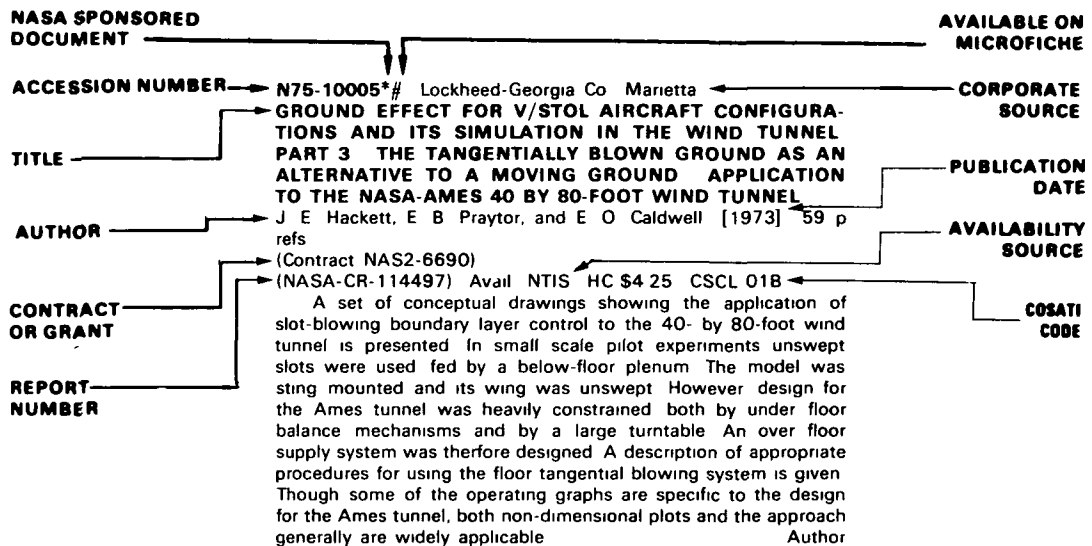
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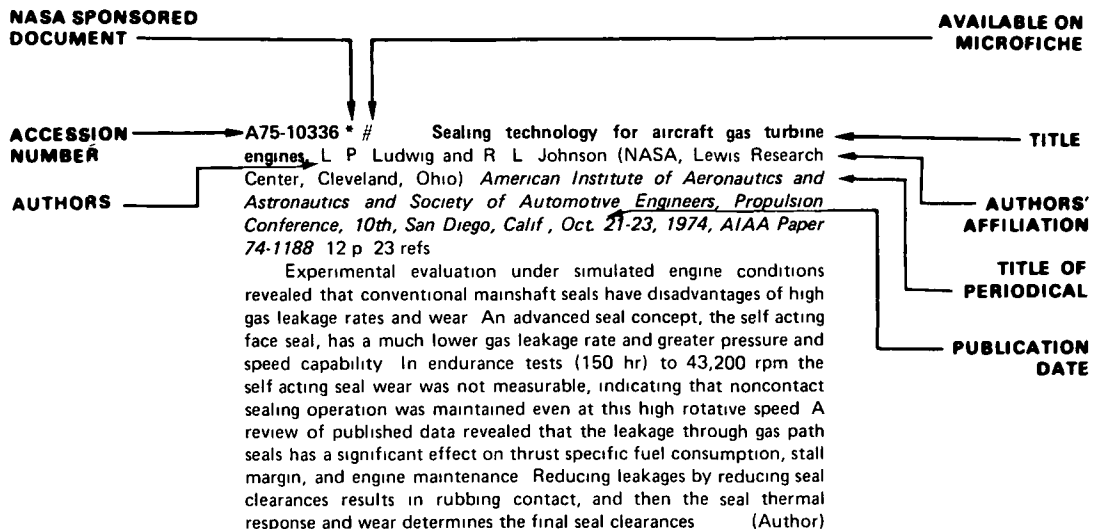
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AERONAUTICAL ENGINEERING

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IAA ENTRIES

A75-45200 * Aircraft landing response in a discrete multipath environment C R Guarino (Atlantic Research Corp., Alexandria, Va.) In International Radar Conference, Arlington, Va., April 21-23, 1975, Record New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p 152 157 14 refs Contract No NAS1 11992

This paper considers the problem of discrete multipath reflections upon an aircraft in the landing phase. A model is developed for the communication channel for a typical receiver. Simulation studies are presented showing the effects of discrete multipath upon the aircraft's ability to follow a specified flight path. A development is presented for the analytical determination of the probability density function of the angular errors (Author)

A75-45410 Lifting-line theory for an unsteady wing as a singular perturbation problem E C James (Tetra Tech, Inc., Pasadena, Calif.) *Journal of Fluid Mechanics*, vol 70, Aug 26, 1975, p 753-771 9 refs Navy-supported research

A linearized theory, which treats unsteady motions of a wing of large aspect ratio at variable forward speed in an inviscid incompressible fluid, is developed, using the method of matched asymptotic expansions. The wing geometry and motions are specified, and the time-dependent lift and moment are obtained. Long time asymptotic behavior of an initial-value harmonic motion is presented, as are the short-time solutions of a wing starting from rest, with constant acceleration and with impulsive acceleration to constant speed. Some attention is given to flapping flight. Results are presented in quadrature form for a general class of unsteady wing motions (Author)

A75-45411 The distortion of a jet by tabs L J S Bradbury and A H Khadem (Surrey, University, Guildford, England) *Journal of Fluid Mechanics*, vol 70, Aug 26, 1975, p 801-813 8 refs Research supported by the Ministry of Defence

In an attempt to explain the discrepancies that have been observed in the spread of nominally axisymmetric jets, an experimental investigation has been carried out in which the effects of a number of factors which it was thought might be important to jet development have been studied. These factors included the nozzle boundary-layer thickness, turbulence level and convergence. However, over the limited range of the tests, it was found that none of these factors had a very strong influence on the jet development. By contrast, the insertion of small rectangular tabs into the jet flow on the nozzle perimeter was found to have a very profound effect on the jet development. In particular, it was found that just two tabs produced gross distortions in the jet development resulting in the jet almost splitting in two with high velocity regions on either side of the diameter joining the tabs. Some explanations for this effect based on further tests with wedges are put forward (Author)

A75-45424 # The 'Lynx' - Into the 80's D Berrington (Westland Helicopters, Ltd., Yeovil, Somerset, England) *Aircraft Engineering*, vol 47, Sept 1975, p 4 8

The basic Lynx design is characterized by high reliability, ease of maintenance, and adaptability to meet a variety of requirements in the 8,000 to 10,000 lb weight range. The number of moving parts in the 'soft' hingeless rotor is much smaller than in the traditional articulated rotor, and the use of conformal gearing in the final drive stage of the main gearbox has greatly reduced the number of gears and bearings from the number present in a conventional epicyclic arrangement. Details on the Automatic Flight Control System, navigation system, and brakes are given. Modifications of the oleo design and instrumentation to meet special purposes are described, and performance and handling specifications are presented. Special production techniques for the cabin roof, rotor hubs, and rotor blades are outlined C K D

A75-45425 # 'Gem' production starts *Aircraft Engineering*, vol 47, Sept 1975, p 10-12, 14

The development of systems and components of the Rolls-Royce Gem gas turbine engine to meet specifications of reliability, safety, ease of maintenance, and performance is outlined. Rig testing of the air and oil systems is described, along with subsequent changes in the nozzle seals to reduce wear and improvements in the low-pressure compressor performance. Details on the final design of engine components are given, together with data on engine performance and compressor operating line efficiency. The uprating program is expected to involve increases in turbine entry temperature and mass flow C K D

A75-45608 # An investigation of the interaction between advanced turbofan controls and assumed performance correction models. M S Coalson and F L Csavina (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1175* 10 p

Advanced turbofan engines strive to control engine airflow and fan operating line in order to optimize performance while maintaining adequate stability margin. Consequently, controls are configured to vary scheduled parameter values through the flight envelope. It is the objective of this paper to investigate the effects that control related changes have on the utility of several possible performance correction models. Performance correction models are used to infer performance at conditions other than those tested to determine specification compliance and for standardization of flight test data. Models now used in industry plus ones developed by the authors are systematically examined for sensitivity to errors associated with changes in control schedules, mode, trim level and engine quality (Author)

A75-45609 * # Application of real-time engine simulations to the development of propulsion system controls J R Szuch (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1176* 10 p 19 refs

The development of digital controls for turbojet and turbofan engines can be facilitated by the use of real time computer simulations of the engines. The engine simulation provides a 'test-bed' for evaluating new control laws and for checking and 'debugging' control software and hardware prior to engine testing. This paper describes the development and use of real-time, hybrid computer simulations of the Pratt & Whitney TF30-P-3 and F100-PW-100 augmented turbofans in support of a number of controls research programs at the Lewis Research Center. The role of engine simulations in solving the propulsion systems integration problem is also discussed (Author)

A75-45610 # Control considerations for lift-cruise engines in a V/STOL fighter aircraft E C Beattie (United Technologies Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1177* 12 p 11 refs

Propulsion system controls for V/STOL fighter aircraft should be designed to accommodate the special aircraft operational requirements such as satisfactory thrust response for height control. Good matching of the engine control to operational requirements may allow the aircraft designer to obtain secondary benefits in terms of aircraft performance and weight. For example, use of differential thrust from the propulsion system for attitude control can result in reductions in Reaction Control System (RCS) weights and levels of engine airbleed required for the RCS. Because engine operational requirements vary as a function of the aircraft configuration, the design of the engine control should be coordinated with the overall aircraft system design process. This paper presents operational requirements for V/STOL propulsion systems for several aircraft configurations and considers engine control concepts to meet these requirements (Author)

A75-45611 # Control system and condition monitoring integration N L Downing (General Motors Corp., Detroit Diesel Div., Indianapolis, Ind.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1179* 13 p 5 refs

Condition monitoring of engine operation is rapidly becoming a wave of the future for new military and commercial aircraft. A study was completed on the TF41 engine which integrated the functions of both the condition monitoring and engine control systems. This resulted in the capability to perform in-flight corrective action, something that neither of the systems can do separately. With the advent of electronic engine controls, much processing of data is already being done by the engine control unit. A strong case can be made for integrating the engine control and condition monitoring unit for more efficient usage and at less cost and weight (Author)

A75-45612 * # A throat-bypass stability system for a YF-12 aircraft research inlet using self-acting mechanical valves G L Cole, M O Dustin, and G H Neiner (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1181* 10 p 11 refs

Results of a wind tunnel investigation are presented. The inlet was modified so that airflow can be removed through a porous cowl-bleed region in the vicinity of the throat. Bleed plenum exit flow area is controlled by relief type mechanical valves. Unlike valves in previous systems, these are made for use in a high Mach flight environment and include refinements so that the system could be tested on a NASA YF-12 aircraft. The valves were designed to provide their own reference pressure, hence, do not respond to slowly varying disturbances. However, the results show that the system can absorb internal-airflow-transients that are too fast for a conventional bypass door control system and that the two systems complement each other quite well. Increased tolerance to angle of attack and Mach number changes is indicated. The valves should provide sufficient time for the inlet control system to make geometry changes required to keep the inlet started (Author)

A75-45614 * # Experimentally determined aeroacoustic performance and control of several sonic inlets B A Miller (NASA, Lewis Research Center, Noise Div., Cleveland, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1184* 16 p 18 refs

Low speed wind tunnel tests were conducted to determine the aeroacoustic performance of several model sonic inlets. The results were analyzed to indicate how inlet aeroacoustic characteristics were affected by inlet design and operating conditions. A system for regulating sonic inlet noise reduction was developed and tested. Results indicate that pressure losses at forward velocity may be substantially less than those at static conditions. This is particularly true for translating centerbody inlets with the centerbody extended in the approach and landing position. Operation to simulated take-off incidence angles of 50 deg was demonstrated with good inlet performance. Results suggest that at takeoff, with 0 deg incidence angle, sonic inlet total pressure losses need not exceed those generated by skin friction for sound pressure level reductions to at least 15 dB. Inlet sound pressure level reduction was regulated to within approximately plus or minus 1 dB by controlling inlet surface static pressure measured at the diffuser exit (Author)

A75-45615 # Unique applications of the method of characteristics to inlet and nozzle design problems P A Henne (Douglas Aircraft Co., Long Beach, Calif.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1185* 10 p 15 refs

This paper describes applications of the Method of Characteristics to inlet and nozzle aerodynamic design problems. The Method of Characteristics is a well-known analytical procedure used to compute exact, inviscid, supersonic flow fields. The applications presented emphasize the powerful and often overlooked inverse solution capability of the Method of Characteristics. Subsonic transport nozzle design problems and supersonic transport inlet design problems are addressed. The new concept of the controlled-expansion nozzle emerged during initial studies and is summarized in detail. Two wind-tunnel tests substantiating this concept are discussed. Interesting design alternatives for supersonic axisymmetric inlets are also presented (Author)

A75-45616 * # Potential and viscous flow in VTOL, STOL or CTOL propulsion system inlets N O Stockman (NASA, Lewis Research Center, Noise Div., Cleveland, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1186* 12 p 17 refs

A method has been developed for analyzing the flow in subsonic axisymmetric inlets at arbitrary conditions of freestream velocity, incidence angle, and inlet mass flow. An improved version of the method is discussed and comparisons of results obtained with the original and improved methods are given. Comparisons with experiments are also presented for several inlet configurations and for various conditions of the boundary layer from insignificant to separated. The paper discusses applications of the method, with several examples given for specific cases involving inlets for VTOL lift fans and for STOL engine nacelles (Author)

A75-45627 # Assessment of engine problem areas in gas turbine-powered commercial aircraft R F Nugent (FAA, Washington, D C) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1203* 5 p

The introduction of gas turbine-powered aircraft into commercial operation reflected an almost immediate and worthwhile reduction in in-flight shutdowns compared to reciprocating engine installations. However, new problem areas foreign to conventional reciprocating engine service operational experience were uncovered, requiring different approaches to their solution. This paper deals with the engine shutdown and premature removal rates experienced from the time of introduction into service up to the present. The predominant problem areas are identified along with proposed corrective measures taken to reduce the incidence rate. Comparative results of reduction in engine in-flight shutdown rate versus

accumulated engine time for both turbojet and turbofan engine installations are discussed (Author)

A75-45628 # Powerplants for wide-bodied aircraft - What we bought and what we got J K Goodwine (United Air Lines, Inc., San Francisco, Calif.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1204* 6 p

The wide-bodied aircraft era, with a new generation of high-bypass ratio propulsion engines, arrived in the early 70's full of promise of ever lower engine operating costs. Now, several years and billions of passenger miles later, we can look back at what we obtained relative to what we thought we bought. This paper reviews the factors which determine engine operating costs, i.e., performance margin, durability, dispatch reliability, and ease of maintenance, and compares one airline's actual experience with their expectations (Author)

A75-45630 # Experimental evaluation of an analytically derived bleed system for a supersonic inlet J Syberg and J L Koncsek (Boeing Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept. 29-Oct. 1, 1975, AIAA Paper 75-1210* 7 p 5 refs

Wind tunnel test results for a large-scale Mach 3.5 inlet model featuring an analytically derived bleed system are compared with flow-field and boundary-layer predictions. The high performance achieved at the design Mach number indicates that boundary-layer bleed requirements can be accurately predicted. The highest engine-face recovery at Mach 3.5 was 85.8%, this was obtained at 0.05 Mach tolerance with 13.4% bleed. In the 'started' Mach number range from 1.6 to 3.5, the total-pressure recovery in the throat, downstream of the terminal normal shock, ranged between 91% and 95%. Subsonic-diffuser losses were significant at some off-design Mach numbers (Author)

A75-45632 * # Inlet performance of the integrated Langley Scramjet Module C A Trexler (NASA, Langley Research Center, Hampton, Va.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1212* 10 p 8 refs

The inlet concept for the Langley Scramjet Module has been developed and proven in Langley wind tunnels over a Mach number range from 2.3 to 6.0 (flight simulation of Mach 2.6 to 7.6). This modular engine concept is designed to integrate with the airframe, which results in precompression of the engine airflow by the vehicle bow shock and additional expansion of the nozzle exhaust gas by the afterbody of the vehicle. With these integration advantages, the inlet can be designed with modest contraction ratios and fixed geometry. Also, the module nozzle exit area can be equal to the capture area, which permits the cowl to be aligned with the local flow producing minimum external drag. The inlet leading edges and planar compression surfaces are swept at 48 deg, which provides spillage at low Mach numbers for starting and which reduces the pressure gradient on the top surface to permit ingestion of the vehicle forebody boundary layer into the inlet without separating. Three fuel injection struts provide for the use of a short combustor having low internal cooling requirements. Schedules for mass capture ratio, contraction ratio, and total pressure recovery are well within the acceptable range for a good scramjet propulsion device. The fixed geometry, minimum external drag design has proven to be a practical, high-performance inlet concept (Author)

A75-45633 * # Propulsion-induced interference effects on jet-lift VTOL aircraft M M Winston, R P Weston (NASA, Langley Research Center, Hampton, Va.), and R E Mineck (U.S. Army Air Mobility Research and Development Laboratory, Hampton, Va.)

American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1215 7 p 10 refs

Recent investigations of propulsion-induced aerodynamics are reviewed. Experimental and analytical studies of the fundamental properties of lifting jet wakes and wind-tunnel investigations of VTOL configuration variables are discussed. The jet-wake flow studies will provide the data base for evaluating theoretical performance prediction methods, while the configuration studies will provide guidance for optimizing airframe/propulsion system integration. The influence of results to date on high-performance VTOL designs emphasizing minimum jet-induced losses and improved thrust vectoring in forward flight (VIFF) capability is illustrated (Author)

A75-45634 # VTOL reingestion model testing of fountain control and wind effects H A Weber and A Gay (General Dynamics, Convair Div., San Diego, Calif.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1217* 9 p

VTOL aircraft operating in ground effect are subject to hot gas reingestion, which induces thrust loss and/or engine stall. Direct measurements of intake reingestion levels have been made over a wide range of operating conditions and wind environments, using a powered aircraft model to reproduce typical VTOL aircraft reingestion patterns. In addition, a test program of a more fundamental nature was initiated, with the objective of obtaining a better understanding of the flow field processes involved, by a detailed study using relatively simple impinging jet geometries. The ultimate goal of this research is the development of an analytical methodology applicable to general configuration evaluations using a semi-empirical approach (Author)

A75-45635 # Propulsion characteristics affecting the aerodynamic performance of an externally blown flap transport model. D R Hoad (U.S. Army, Air Mobility Research and Development Laboratory, Hampton, Va.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1218* 8 p 14 refs

This paper presents a comparison of the performance of two externally blown flap (EBF) wind-tunnel models with an engine exhaust-flap impingement correlation parameter. One model was a four-engine EBF triple-slotted flap transport. Isolated engine wake surveys were conducted to define the wake properties of five separate engine configurations for which performance data were available. The other model was a two-engine EBF transport for which no engine wake properties were determined. The correlation parameter was a function of engine exhaust dynamic pressure at the flap location, ratio of engine-exhaust-flap impingement area to total exhaust area at the flap location, and engine thrust. The distribution of dynamic pressure for the first model was known, however, it was assumed uniform for the second model. This paper also presents a comparison of the results from a wind-tunnel investigation to determine the upflow angle near the inlets of an EBF model and an estimated angle based on the vortex lattice method. It was found that this method was sufficient to predict the upflow angle if the thrust-removed lift coefficient (total circulation lift) was used as input (Author)

A75-45636 # A basic three-dimensional wing/jet interaction experiment C. A. Shollenberger and D R Kotansky (McDonnell Douglas Corp., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1219* 13 p 18 refs

A wind tunnel investigation of strong interactions between a rectangular planform wing and a jet produced by an ejector-powered nacelle is described in detail. Results of these tests are intended to provide a data base for validation of analytical prediction schemes

and to provide insight into fundamental behavior of wing and jet combinations. The configuration tested corresponded to a wing with two nacelles positioned along its span. Results presented include the isolated nacelle jet characteristics, wing chordwise loadings, spanwise wing lift distributions, total wing lift values, and flow visualization observations. A wide variety of wing and jet parameters was studied, including wing angle of attack, wing aspect ratio, jet position, jet angle and jet/freestream speed ratio (Author)

A75-45666 * # Predicted exhaust emissions from a methanol and jet fueled gas turbine combustor. H G Adelman, L H Browning, and R K Pefley (Santa Clara, University, Santa Clara, Calif.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1266* 10 p 19 refs. NASA-supported research.

A computer model of a gas turbine combustor has been used to predict the kinetic combustion and pollutant formation processes for methanol and simulated jet fuel. Use of the kinetic reaction mechanisms has also allowed a study of ignition delay and flammability limit of these two fuels. The NOX emissions for methanol were predicted to be from 69 to 92% lower than those for jet fuel at the same equivalence ratio which is in agreement with experimentally observed results. The high heat of vaporization of methanol lowers both the combustor inlet mixture temperatures and the final combustion temperatures. The lower combustion temperatures lead to low NOX emissions while the lower inlet mixture temperatures increase methanol's ignition delay. This increase in ignition delay dictates the lean flammability limit of methanol to be 0.8, while jet fuel is shown to combust at 0.4 (Author)

A75-45676 # An overview of new concepts for engine development process. E G Koepnick and C M High (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1286* 5 p

The life cycle development and management process for turbine engines is being revised to provide more durable, reliable, and lower life cycle cost engines to the military services. Greater attention is being given earlier in the life cycle to the cost trades between performance, producibility, and operability/supportability, i.e., during the technology, conceptual, and validation phases of the development process. The full-scale development phase has been restructured to provide formal demonstrations of useful engine life limits, operational and logistic characteristics, and validation of the engine life management process to provide economic management rationale for the production hardware acquisition, operational usage, and logistic support phases (Author)

A75-45677 # Engine life cycle cost - A laboratory view. R F Panella (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1287* 4 p

The engine related cost throughout the life cycle of the aircraft weapon system is addressed. The cost associated with each phase (development, acquisition and operational) of the engine life cycle is investigated from a laboratory viewpoint. In the development phase, a significant part of the engine related cost is for hardware, and factors driving hardware cost are identified. Acquisition cost can be a major portion of life cycle cost, and techniques for estimating and controlling engine acquisition costs are explored. The cost associated with the operating and support phase is examined, and certain elements influencing this cost are identified (Author)

A75-45678 # Engine life cycle cost modeling in the conceptual phase. C E Curry (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA*

Paper 75-1288 8 p 7 refs

DOD requirements are considered and a typical functional system flow is shown. Once the systems requirement is established, design teams develop a concept to answer the stated operational need. This concept generally includes a mission analysis, performance characteristics, and a schedule interface. A program example is presented, taking into account a turboshaft engine, which powers the Army Heavy Lift Helicopter. The example illustrates the depth of information that must be considered and made available to the designer early in the concept phase of the product life cycle. G R

A75-45679 # Logistics management of F100 engine through operational introduction. R L Caleen (United Technologies Corp., Pratt and Whitney Aircraft Div., West Palm Beach, Fla.), T E Bahan, and E A Johnson, Jr (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1291* 8 p

The F100 represents a significant advance in terms of improved thrust-to-weight ratio that is so important to a fighter application. Attention is given to the engine development status at the time of the flight test, the flight test plan, procedures and tools used to plan and control the program, the organization for complete support of the aircraft engine system, and the procedures used to implement the program. Questions of F-16 support as related to life cycle cost are examined and the objectives of the component improvement program are discussed. G R

A75-45681 * # The effect of Reynolds number on the boattail drag of two wing-body configurations. D E Reubush (NASA, Langley Research Center, Hampton, Va.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1294* 8 p 18 refs

An investigation has been conducted in the Langley 1/3-meter transonic cryogenic tunnel to determine the effects of varying Reynolds number on the boattail drag of wing-body configurations at subsonic speeds. Two boattailed cone-cylinder nacelle models were tested with a 60 deg delta wing at an angle of attack of 0 deg. Reynolds number, based on model length, was varied from about 2.5 million to 67 million. Even though the presence of the wing had large effects on the boattail pressure coefficients, the results of this investigation were similar to those previously found for a series of isolated boattails. Boattail pressure coefficients in the expansion region became more negative with increasing Reynolds number, while those in the recompression region became more positive. These two effects were compensating, and as a result, there was virtually no effect of Reynolds number on boattail pressure drag (Author)

A75-45682 * # Effect of empennage interference on single-engine afterbody/nozzle drag. B L Berrier (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1296* 10 p 15 refs

An investigation has been conducted in the Langley 16-foot transonic tunnel to determine the effects of empennage surfaces on single-engine afterbody and nozzle drag at Mach numbers up to 1.20. Empennage interference drag was obtained by using experimental values of afterbody/nozzle drag and theoretical values of empennage drag. Three methods for minimizing adverse empennage interference effects were investigated. Results show that empennage interference effects were always detrimental but could be reduced by proper location of tail surfaces. Afterbody contouring and addition of 'contour' bumps were generally ineffective in reducing aft-end drag for Mach numbers less than 0.95 (Author)

A75-45683 # Integrated scramjet nozzle/afterbody performance analysis. J A Sadunas (Rockwell International Corp., Space Div., Downey, Calif.) *American Institute of Aeronautics and*

Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1297 10 p 12 refs

A 2-D flow field computer program developed for preliminary performance analysis of integrated scramjets is presented. Scramjet flow fields are computed by means of the shock-capture technique with real gas thermodynamic properties for frozen and equilibrium compositions. The program computes internal and external flow fields with multiple shock interactions. Interaction of the exhaust, (under-expanded or over-expanded) with the external stream and vehicle afterbody is also considered. Forces and moments are computed due to stream thrust and external surface pressure distributions. Typical program results for parametric nozzle-afterbody design and off-nominal performance analysis are presented. (Author)

A75-45688 * # Gas turbine combustor stabilization by heat recirculation. A Ganji, J Short, M C Branch, and A K Oppenheim (California, University, Berkeley, Calif.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1304 6 p 7 refs* Grant No. NsG-3028

The feasibility of heat recirculation for stabilization of lean mixtures and emission reduction has been studied in detail for a typical aircraft gas turbine combustor. Thermodynamic calculations have indicated temperature and heat recirculation rates for operation of the combustor over a range of combustion zone equivalence ratios and for varying modes of desired engine operation. Calculations indicate the feasibility of stabilizing the combustion zone at equivalence ratios as low as 0.2 with achievable heat recirculation rates. Detailed chemical kinetic calculations suggest that combustor heat release is maintained with reaction completion substantially before the NO forming reactions, even though CO is rapidly oxidized in this same region. (Author)

A75-45689 # An analytical model for predicting exit temperature profile from gas turbine engine annular combustors. G. B Cox, Jr (United Technologies Florida Research and Development Center, West Palm Beach, Fla.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1307 10 p 11 refs*

An analytical model has been developed for predicting exit radial temperature profile from gas turbine engine annular primary combustors. The model assesses the effect of changes in dilution or cooling air distribution, changes in combustor aft end geometry, or changes in combustor operating conditions. The description of the dilution air mixing process includes the effects of mixing in confined flows, closely spaced dilution jets, and elongated dilution ports, the interaction of opposing rows of dilution jets, and the effect of flow area convergence, including nonsymmetric convergence. The cooling air mixing process description includes the effect of combustor turbulence, the effect of multiple louvers, and the effect of flow area convergence. Comparison of measured exit temperature profile shifts, with the predictions of the analytical design system, shows good agreement in predicting the effects of both dilution and cooling air shifts within the combustor aft end. (Author)

A75-45690 # Gas turbine engine inspections - What to look for and why. D A Anderson, P J Henderson, E W Horn, and W R Taylor (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1309 8 p*

Commercial and military aircraft engines are designed to meet specific requirements. To insure that these requirements are met, several verification tests are required. These tests are designed to demonstrate engine performance, stability and durability. This paper is directed toward the evaluation of engine durability based on hard-ware condition after endurance testing and will identify the

critical locations throughout the engine and the specific conditions which are of concern. The subject is applicable to both development and production engine problems which can be attributed to inadequate engine durability. (Author)

A75-45692 # Design and qualification of foreign object damage resistant turbofan blades. G B Fulton (United Technologies Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1313 10 p*

Aircraft gas turbines are subject to damage by airborne foreign objects such as birds and ice. This paper reviews the nature of the foreign object damage (FOD) hazard and its frequency of occurrence. Classification of ingested objects and Federal Aviation Agency requirements for certification are reviewed. Two simple stress factors used to assess blade resistance to impact damage are discussed and the way these factors vary with blade geometry is illustrated. The interaction of FOD stress factors with aerodynamics, steady stress, and aeroelastic considerations is summarized. A recently-completed engine FOD certification test is described and examples of typical ingestion damage are shown. An extension of the analytical impact model to the optimization of advanced fan blades is presented together with some strain vs time comparisons between analysis and test. (Author)

A75-45693 # Development of the YC-14 propulsion system. C A Grotz (Boeing Co., Seattle, Wash.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1314 15 p 5 refs*

This paper provides a description of the unique over-the-wing propulsion system of the Boeing YC-14 twin engine STOL transport airplane. It also discusses inlet requirements, design philosophy and development, low speed and high speed nozzle development, engine/nozzle matching procedures and thrust reverser model testing. Superior inlet performance was achieved by using special lip contours in conjunction with a high contraction ratio. One sixth scale model tests of various lip designs were used for inlet selection. An empirical relationship between steady state distortion and dynamic distortion was established. The powered lift system uses upper surface blowing to achieve thrust deflection by turning the exhaust jet over the wing/flap by the Coanda effect. The physical devices used to turn the relatively thick exhaust jet are discussed with performance data being presented to show nozzle velocity coefficients, thrust vectoring capability, flow coefficients and cruise drag. Engine/nozzle matching data are presented to show the procedures used to select nozzle design areas for the confluent system. The thrust reverser represents a state of the art advancement in reverser designs since it is the first developed for over the wing nacelles. Basic geometry and reverser model performance data are presented. (Author)

A75-45694 * # A summary of experimental research on propulsive-lift concepts in the Langley 16-foot transonic tunnel. F J Capone (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1315 12 p 17 refs*

A summary of research on both conceptual and practical configurations in which the aircraft's powerplant is integrated to take advantage of propulsion-induced aerodynamics conducted in the Langley 16 foot transonic tunnel has been made. These investigations included (1) vectoring a partial-span jet exhaust at a wing trailing edge, (2) thrust vectoring characteristics of a twin, two-dimensional variable-geometry wedge nozzle, (3) a jet exhaust/upper surface blowing concept for fighter aircraft, and (4) jets blowing over the wing. These studies indicate a potential for increasing maneuverability of fighter aircraft at high lift coefficients. With proper integration

of the powerplant and the airframe, significant improvements in cruise performance of both fighter and transport aircraft are possible (Author)

A75-45695 # Study of non-axisymmetric nozzles installed in advanced fighter aircraft P E Hiley, H W Wallace (McDonnell Aircraft Co, St Louis, Mo), and D E Booz (United Technologies Corp, Pratt and Whitney Aircraft Div, West Palm Beach, Fla) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1316* 10 p USAF sponsored research

A study program was conducted to investigate the characteristics of vectoring/reversing nonaxisymmetric nozzles installed in advanced fighter aircraft. Several promising non-axisymmetric nozzle concepts ranging from two-dimensional convergent-divergent to two-dimensional plug designs were evaluated. A vectoring axisymmetric nozzle was analyzed for comparison. These nozzles were evaluated in aircraft configured for aft-mounted nozzle installations, and all incorporated pitch-plane thrust vectoring of plus or minus 15 deg. Some included thrust reversing capability. Aircraft performance was evaluated in terms of takeoff gross weight (TOGW) for comparisons of nonaxisymmetric and conventional axisymmetric nozzle installations. The most significant TOGW benefits were achieved when the aircraft sizing point occurred at high lift coefficient conditions. Combat effectiveness benefits in terms of aircraft deceleration capability and infrared radiation suppression were identified, along with nozzle cost and complexity advantages (Author)

A75-45696 * # Investigation of two-dimensional wedge exhaust nozzles for advanced aircraft D L Maiden (NASA, Langley Research Center, Hampton, Va) and J E Petit (Boeing Aerospace Co, Seattle, Wash) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1317* 11 p 14 refs

Two-dimensional wedge nozzle performance characteristics were investigated in a series of wind-tunnel tests. An isolated single-engine/nozzle model was used to study the effects of internal expansion area ratio, aftbody cowl boattail angle, and wedge length. An integrated twin-engine/nozzle model, tested with and without empennage surfaces, included cruise, acceleration, thrust vectoring and thrust reversing nozzle operating modes. Results indicate that the thrust-minus-aftbody drag performance of the twin two-dimensional nozzle integration is significantly higher, for speeds greater than Mach 0.8, than the performance achieved with twin axisymmetric nozzle installations. Significant jet-induced lift was obtained on an aft-mounted lifting surface using a cambered wedge center body to vector thrust. The thrust reversing capabilities of reverser panels installed on the two dimensional wedge center body were very effective for static or in-flight operation (Author)

A75-45697 # Augmented Deflector Exhaust Nozzle (ADEN) design for future fighters J A Lander, D O Nash (General Electric Co, Cincinnati, Ohio), and J L Palcza (US Naval Air Propulsion Test Center, Trenton, N.J.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1318* 11 p

A two-dimensional Augmented Deflector Exhaust Nozzle (ADEN) has been selected as a high potential exhaust system for advanced multimission V/STOL aircraft. The ADEN selection was based on the results of a Navy Advanced V/STOL Propulsion Component Development Program. This program included a comprehensive series of aerodynamic and mechanical design studies, aircraft system studies and scale model experimental test programs. ADEN detailed mechanical design has been completed and hardware fabrication for a full size ADEN demonstration test on a General Electric YJ101 engine is underway. This paper presents the aero-

dynamic and mechanical features of the ADEN and describes the upcoming full scale demonstrator program (Author)

A75-45698 # Support interference on nozzle afterbody performance at transonic Mach numbers R C German (ARO, Inc, Arnold Air Force Station, Tenn) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1320* 10 p

Incremental changes in boattail and base pressures resulting from changes in support strut design and location were obtained from wind tunnel tests on a sting-mounted cylindrical model with an ogive nose. The interference coefficients on the nozzle afterbody (NAB) were obtained with a cylindrical afterbody and with a 10-deg boattail, conical afterbody for two strut locations and three sweep angles at Mach numbers from 0.6 to 1.4. The effect of changing local wall porosity on NAB performance was investigated. The results provide additional information on wind tunnel test techniques and on interferences resulting from support strut and tunnel wall-shock interactions during NAB tests at transonic speeds (Author)

A75-45699 # Effect of Reynolds number on the nozzle afterbody performance of the AGARD nozzle afterbody and the B-1 0.06-scale model at transonic Mach numbers C E Robinson and E A Price (ARO, Inc, Arnold Air Force Station, Tenn) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1321* 11 p 5 refs

Two experimental investigations were conducted to study the effects of Reynolds number on nozzle afterbody (NAB) performance. In the isolated NAB investigation a cone-cylinder model with AGARD NAB was used, whereas in the B-1 investigation a 0.06-scale model of the B-1 aircraft was used. The effect of Reynolds number on NAB performance was studied over the transonic Mach number range with a variation in characteristic Reynolds number from approximately 10 to 100 millions for the isolated NAB program and 1 to 10 millions for the B-1 program. The Reynolds number variation produced approximately a 2-percent increase in total airplane force coefficient and appeared to be Mach number dependent for both programs (Author)

A75-45700 # An experimental investigation of ground vortex formation during reverse engine operation D L Motycka and W A Walter (United Technologies Corp, Pratt and Whitney Aircraft Div, East Hartford, Conn) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1322* 5 p

Ground vortex formation has been identified as a prime cause of gas turbine engine surges during reverse operation. An inlet model test was run to evaluate the effect of reverser targeting, engine power setting, inlet height and aircraft ground speed on ground vortex formation during reverse operation. The effects of these variables on instantaneous inlet pressure distortion are described. Results of testing clearly show the presence of ground vortex during reverse operation. Engine power setting, inlet height and reverser targeting are shown to have a significant effect on the level of inlet distortion generated during reverse operation (Author)

A75-45701 # High accuracy force accounting procedures for turbopowered simulator testing R Decher and D C Tegeler (Boeing Commercial Airplane Co, Seattle, Wash) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif, Sept 29-Oct 1, 1975, AIAA Paper 75-1324* 16 p 13 refs

This work summarizes the development of procedures and facilities necessary for subsonic wind tunnel testing of nacelles with turbopowered engine simulators. The goal was to delineate nacelle development testing procedures that keep track of thrust and drag accurately and in a manner consistent with the accounting procedure

used in full-scale transport aircraft. The results presented include a discussion of the static calibration facilities developed to minimize bias errors and a discussion of a numerical error analysis technique to minimize random error. The results of an isolated and an installed nacelle test are presented as a confirmation of the validity of the procedure. The procedure is shown to yield model thrust or drag uncertainty well within 1%. (Author)

A75-45702 # Effects of condensation in the JT9D turbofan engine bellmouth inlet J C Blake (United Technologies Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1325* 10 p.

Water vapor condensation occurs within the JT9D turbofan engine test inlet and results in penalties in measured fuel consumption which are often as much as 0.5% and which, if not accounted for, can lead to substantial errors in interpreting development program test results. Analysis had indicated that condensation was theoretically possible at normal humidity levels occurring in the Hartford area and that substantial penalties in engine performance could result. An engine test program was, therefore, initiated to substantiate the analytical results. A laser photo-sensor system was devised to detect the presence of condensate within the engine inlet. This system provided evidence that condensation occurred at the conditions predicted by theory. An extensive engine test program was then conducted in which variations in JT9D engine thrust specific fuel consumption, TSFC, were measured over a wide range of ambient conditions. The changes in measured TSFC were found to correlate with the predicted amount of condensation. The correlation which was established is currently used to correct JT9D engine performance data for condensation effects. (Author)

A75-45704 # Ground noise suppressors for aircraft engine operation. C J Miller (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1327* 6 p.

The U.S. Air Force objectives for reducing noise generated during ground engine runups and the required performance parameters for noise suppressors will be presented. Past history of Air Force development programs and industry programs which resulted in the rationale for the design criteria presently being used will be reviewed. The limitations and problems being experienced with the present design and a list of candidate development programs will be provided. (Author)

A75-45705 # Integrating ground support for propulsion systems on the 747 A H Sargent and W P Newell (Boeing Co., Seattle, Wash.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 11th, Anaheim, Calif., Sept 29-Oct 1, 1975, AIAA Paper 75-1329* 12 p.

Each engine in use and planned for the Boeing 747 presents unique ground support requirements for the airframe manufacturer. Specialized engine installation and removal equipment, transport requirements, procedures and handling data must be developed and documented. Unique airline customer requirements, like lower lobe cargo bay air transport of engines, must be coordinated by the manufacturer with engine supplier, airline, and ground equipment vendors. Common nacelle programs are a new dimension in ground support integration. All of these aspects, their problems, solutions and the management process used in integrating propulsion system ground support are discussed. (Author)

A75-45726 Theory of air-breathing jet engines (Teoriya vozdukhno-reaktivnykh dvigatelei) Edited by S M Shliakhtenko. Moscow, Izdatel'stvo Mashinostroenie, 1975 568 p 59 refs. In Russian.

The book sets forth the basic principles in the theory of aviation air-breathing jet engines of the principal types. This includes turbojet engines and bypass engines, turboprop and ramjet engines, some special rocket-jet and rocket-ramjet engines, and jet engines with atomic reactor. Detailed analyses cover the characteristics of thermodynamic cycles, the principles of optimal parameter selection, the altitude-velocity and throttle characteristics for various control laws, and noise phenomena of jet engines. P T H

A75-45731 # Reliability of control systems (Nadezhnost' sistem upravleniya) A D Epifanov. Moscow, Izdatel'stvo Mashinostroenie, 1975 179 p 31 refs. In Russian.

The present work deals with calculations of reliability for aircraft control systems. The discussion covers factors affecting the control system reliability of an aircraft, methods for calculating reliability in the presence of sufficient and insufficient information, optimization of control system structure on the basis of derived reliability criterion, and reliability of measuring instruments and control units. The choice of control system structure is determined using an exponential model for the relation of reliability to the characteristics of the control system. A double logarithmic transformation reduces this model to a linear one, which greatly facilitates solution of the problem regarding the choice and optimization of the structure of a control system on the basis of the reliability criterion. S D

A75-45877 # An experimental study of flap-induced separation of a compressible turbulent boundary layer J C Winterwerp (Institut von Karman de Dynamique des Fluides, Rhode-Saint-Genese, Belgium) *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept 21-27, 1975, Paper ST-75-06* 38 p. Research supported by the Institut von Karman de Dynamique des Fluides and Technische Hogeschool te Delft.

Results are reported for detailed static pressure measurements conducted in a compressible turbulent boundary layer at a compression corner on a wind tunnel wall. The tests were performed in supersonic and hypersonic wind tunnels, and the compression corner was formed by different wedges with various wedge angles. It is shown that techniques based on static-pressure distributions cannot detect small separated regions in a compression corner but that correlation methods based on the initial occurrence of a pressure rise in the disturbed boundary layer are more promising. The free-interaction principle is found to be valid beyond the separation point almost up to the hinge line of the compression corner. F G M

A75-45881 An analytical model for the control of low flying aircraft and vehicles by visual cues A. Grunwald (Technion - Israel Institute of Technology, Haifa, Israel). *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept 21-27, 1975, Paper ST-75-01* 38 p 6 refs.

This paper represents the development and experimental validation of an analytical model for manual visual field control (VFC) of aircraft. A basic model for the control oriented visual field information (VFI) is proposed and formulated in an optimal control framework. A special case of VFC is studied, namely, the manual lateral control of a TV-guided remotely piloted vehicle (RPV) along a straight reference trajectory in the presence of side gusts. For experimental validation, a five-degree-of-freedom fixed-base simulator has been constructed to simulate a RPV flight along a nominally straight reference trajectory. (Author)

A75-45887 # The Airfloat GP project E Mowforth (Airfloat Transport, Ltd., Surrey, University, Guildford, England) *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept 21-27, 1975, Paper 8 p.*

A general description of a rigid Airfloat general purpose airship designed for operation as a ferry between two fixed bases is given.

The hull construction, fuel system, and various safety features are discussed, and performance data for the Marine Gnome gas turbines are presented. The base facilities and a typical module exchange sequence are described. C K D

A75-45888 # The Airfloat HL project E Mowforth (Airfloat Transport, Ltd., Surrey, University, Guildford, England) *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept 21-27, 1975, Paper 10 p*

The Airfloat Heavy Lift (HL) ship is designed for production speed and economy and is intended to carry large indivisible loads over moderate distances. Design of its motor and hull is described, and fuel storage and ballasting in oil-burning, natural gas, and dual fuel versions are discussed. Data on range payload relationships and gross disposable lift are given. Open site and module operation procedures are described and cost figures for the operation of the various HL versions under each system are presented. The hull length is 400 m, the distance is 85 m, and the helium capacity is 1,342,000 cu m. C K D

A75-45897 # Rules and regulations on lighter-than-air craft P Magno and C Verdacchi (Istituto Italiano di Diritto Spaziale, Rome, Italy) *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept 21-27, 1975, Paper 13 p*

The paper calls attention to juridical principles and norms which relate in one way or another to lighter-than-air craft, in particular, captive and free balloons. The applicability of existing air navigation norms to balloons is examined by giving attention to the framework of Italian national norms, ICAO norms, and the 'Treatise on principles governing the activities of States in matters of exploration and utilization of the extra-atmospheric space, including the moon and other celestial bodies' of Jan 27, 1967, and subsequent integrative international agreements. P T H

A75-45898 # The case for the wide-bodied airship L C Laming, M M Gibson, and G W Tunley (Imperial College of Science and Technology, London, England) *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept 21-27, 1975, Paper 24 p 5 refs*

It is pointed out that the major obstacles to the revival of the airship in a cargo role are related to landing problems, which a Zeppelin-type airship of the required size would experience. A 'wide-body' airship design is recommended for overcoming the landing problems. The mooring technique for the proposed type of airship is discussed along with the airship structure and aerodynamic implications. The economic aspects of airship operation are also investigated, giving attention to fixed and variable expenditure. G R

A75-45899 # The aerodynamics of large rigid airships M M Gibson and L C Laming (Imperial College of Science and Technology, London, England) *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept 21-27, 1975, Paper 23 p 40 refs*

The investigation reported is concerned with a number of aerodynamical aspects which affect the basic configuration and performance of the very large airship in its proposed role as a freight carrier. The response of a large full-bodied airship to small disturbances from initially-steady flight is considered. Questions of aerodynamic stability are investigated, taking into account longitudinal stability and details of the disturbed longitudinal motion. It is pointed out that any new airship project must employ substantial resources in an experimental program in which the determination of the principal stability derivatives will be a major objective. G R

A75-45901 A survey of lighter than air systems and their applications in scientific fields L G Napolitano, S Vetrèlla (Napoli, Università, Naples, Italy), and A Castellani (Consiglio Nazionale

delle Ricerche, Rome, Italy) *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept 21-27, 1975, Paper 75-LAS-10 13 p 11 refs*

In the first section of this paper, a joint effort of the Aerodynamics Institute of Naples and the National Research Council of Rome, different classes of lighter than air systems of actual or potential use are presented (balloons, airships, hybrid systems and so on). In the second section the Italian ARGO project is described, with particular reference to the first experiment concerning the use of a captive balloon under 1000 m. (Author)

A75-46150 # LTA vehicle concepts to six million pounds gross lift J Lancaster (Goodyear Aerospace Corp., Akron, Ohio) *American Institute of Aeronautics and Astronautics, Lighter Than Air Technology Conference, Snowmass, Colo., July 15-17, 1975, Paper 75-931 15 p 11 refs*

A summary of the results of a parametric analysis of three classes of modern airship vehicles is presented. Vehicle concepts include conventional fully buoyant ellipsoidal airships, semibuoyant ellipsoidal airships, and a family of modified delta-planform lifting-body hybrids. Maximum productivity is the criterion for optimization of vehicle design and operational characteristics. The percentage of gross weight supported by buoyant lift is treated parametrically as a function of gross weight, design range, configuration characteristics, and cruise velocity for the semibuoyant vehicle concepts. For the vehicle concepts considered, structural weight and design range are the principle factors which influence the parameter trends for maximum productivity. Comparisons are presented among the three vehicle classes and with current aircraft transports. (Author)

A75-46154 # Hydrodynamic stability of the far wake of a hovering rotor B P Gupta (Bell Helicopter Co., Fort Worth, Tex.) and M Lessen (Rochester, University, Rochester, N Y) *AIAA Journal*, vol 13, June 1975, p 766-769 5 refs

The stability of a continuous model for the far wake of a hovering rotor has been formulated and analyzed. In the continuous model representation of the far wake, the vorticity of the interdigital circular vortex helices is assumed to be distributed over a vortex sheet, and the potential flow inside and outside of the vortex sheet is taken to correspond to the average velocity profiles calculated for an interdigitated representation. A continuum of instabilities is found to exist for all wave numbers and for all modes except in some specific situations where the flow is neutrally stable. This model gives the instabilities of the gross flow and complements the interdigitated analysis of Gupta and Loewy (1974), which is the companion analysis for the instabilities of centerline displacements of the vortex helices. (Author)

A75-46172 * # Stress corrosion susceptibility of stress-coined fastener holes in aircraft structures A E Carter and S Hanagud (Georgia Institute of Technology, Atlanta, Ga.) *AIAA Journal*, vol 13, July 1975, p 858-863 12 refs Grant No. NGR-11-002-169

The cold working process of stress coining is used to provide fatigue improvement of fastener holes in aircraft structures. The cold working produces a radial flow of the metal. The residual stresses resulting from stress coining provide protection against fatigue damage by opposing the applied tensile stresses in service at the edge of the fastener hole. However, it is shown in this paper that in addition to the compressive stresses surrounding the stress coined hole, there are tensile stresses that result from the coining operation and that these residual tensile stresses can have a deleterious effect on the stress corrosion susceptibility of the postcoined structure. (Author)

A75-46178 # Extended integral equation method for transonic flows D Nixon *AIAA Journal*, vol 13, July 1975, p 934, 935

The approximate evaluation of a field equation by a standard integral equation method, although adequate for subcritical flows, is

not quite accurate to yield satisfactory results for supercritical flows in the presence of shock waves. In the integral equation method, the nonlinear transonic small disturbance equation is written in integral form consisting of a line integral over an airfoil chord and a double integral with second-order terms over the entire flow field. An extended integral equation method is proposed as an alternative means of evaluating the field integral, where the fundamental integral equation is used to find velocities in the flow field in addition to the surface velocities. This results in a significant improvement in the accuracy of the integral equation method. The discussion is limited to the flow over a symmetric airfoil at zero incidence, although the extended integral equation method can be successfully applied to a wide range of problems. S.D.

A75-46189 * # Experimental verification of turbulent skin friction reduction with compliant walls. L. M. Weinstein, M. C. Fischer (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.), and R. L. Ash (Old Dominion University, Norfolk, Va.) *AIAA Journal*, vol. 13, July 1975, p. 956-958. 9 refs.

Preliminary compliant wall skin friction test results obtained in a low-turbulence pressure tunnel are reported. Compliant surface skins consisted of 0.0025 cm thick mylar, stretched under tension and area-bonded or longitudinally strip-bonded with silicone rubber adhesive to polyurethane foam. Mean velocity and fluctuating survey data were obtained with a single slanted hot wire. Mean velocity profiles for the area-bonded mylar surface skins indicated up to a 20% reduction in boundary-layer thickness (and lower momentum thickness) over rigid surfaces. This reduction in boundary-layer thickness indicates that a drag reduction occurred. In addition, a 16% reduction in wall shear was evident for the mylar/compressor foam compliant surface. S.J.M.

A75-46297 # Entropy layer in the problem of hypersonic flow about thin blunt bodies that are nearly two-dimensional (Ob entropinom sloe v zadache giperzvukovogo obtekania tonkikh prituplennykh tel, blizkikh k dvumernym). N. E. Ermolin *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, May-June 1975, p. 74-81. 8 refs. In Russian.

A solution in the entropy layer is developed for the problem of hypersonic flow about thin blunt bodies that are nearly two-dimensional by an inviscid non-heat-conducting gas. The solution procedure is outlined, and the solution is given in the form of asymptotic expansions. It is found that in the zero approximation, a singularity exists at the surface of a blunt body since the entropy function becomes infinitely large. Attempts to construct successive approximations only aggravate the singularity, so the method of deformed coordinates is used to remove it. It is shown that this technique allows a solution to be developed which is uniformly valid in the entire flow except for the entropy layer. In practice, the development of such a solution leads to a displacement of the flow lines near the body's surface, resulting in 'absorption' of the singularity by the body and assuring a singularity-free solution outside the body. In the zero approximation, this displacement of the flow lines is determined in closed form. F.G.M.

A75-46473 Continuous hydrogen furnace brazing of aircraft heat exchangers. L. B. Lindsay (Midland-Ross Corp., Columbus, Ohio) and D. F. Wireman (Aerobrazo Corp., Cleveland and Cincinnati, Ohio) *Welding Journal*, vol. 54, Oct. 1975, p. 737-739.

The application of controls during the production of brazed-jointed stainless steel heat exchanger modules using BNI-3 as the braze filler material is discussed. Completed modules undergo fluorescent penetration inspection of brazed modules, pressure testing, and metallographic evaluation. Chemical cleaning to achieve maximum wettability of the base metal, maintenance of a maximum gap of 0.003 in., and proper control of the brazing temperature, time at temperature, and temperature uniformity are essential to prevent leakage under high pressures. C.K.D.

A75-46476 Composite materials Volume 3 - Engineering applications of composites Volume 4 - Metallic matrix composites Volume 8 - Structural design and analysis, Part 2. Edited by B. R. Noton (Battelle Columbus Laboratories, Columbus, Ohio), K. G. Kreider (National Bureau of Standards, Institute of Applied Technology, Gaithersburg, Md.), and C. C. Chamis (NASA, Lewis Research Center, Cleveland, Ohio). New York, Academic Press, Inc., 1974. 1975. Vol. 3, 533 p., vol. 4, 501 p., vol. 8, 312 p. Price of vol. 3, \$34.50, vol. 4, \$32.50, vol. 8, \$29.75.

This volume discusses a variety of applications of both low- and high-cost composite materials in a number of selected engineering fields. The text stresses the use of fiber-reinforced composites, along with interesting material systems used in the electrical and nuclear industries. As to technology transfer, a similarity is noted between many of the reasons responsible for the utilization of composites and those problems requiring urgent solution, such as mechanized fabrication processes and design for production. Features topics include road transportation, rail transportation, civil aircraft, space vehicles, building industry, chemical plants, and appliances and equipment. The laminate orientation code devised by Air Force materials laboratory is included.

S.D.

A75-46477 * Civil aircraft. N. J. Mayer (NASA, Office of Aeronautics and Space Technology, Washington, D.C.) In *Composite materials Volume 3*. New York, Academic Press, Inc., 1974, p. 23-68. 24 refs.

This study deals with aircraft material and structural requirements, advantages of composites, airframe and engine applications, design procedures, problem areas, and future trends in civil aircraft. The selection of materials and design of structure for any given component or part must be made not only on the basis of the mechanical and structural functions, but must also consider the operational and cost parameters for civil aircraft. Composites have caused the orientation to shift from a metal-based philosophy for design, where only incremental improvements could be anticipated, to one where substantial changes in design approaches are possible. Future designs are likely to include a combination of new approaches and composite materials. S.D.

A75-46479 Military aircraft. P. A. Parmley (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In *Composite materials Volume 3*. New York, Academic Press, Inc., 1974, p. 119-161. 29 refs.

The use of boron- and graphite reinforced composites in military aircraft wings, empennage structures, fuselages, and other aircraft components is surveyed. In particular, the mechanical behavior of T-39 center wing box, F-100 wing covers, the F-111B boron wing tip, advanced composite wing structures, composite box beam optimization, and flight wings is analyzed under different structural concepts and testing conditions. The F-14 stabilizer represents the first boron composite production part used in the primary structure of an aircraft, with the selection of the material for the skins being based on consideration of weight and cost. Although dramatic weight savings, higher stiffness, improved life endurance characteristics, and corrosion resistance are achieved, there still remains a significant potential for further improvements in weight savings and vehicle mission performance, provided design and fabrication are unimpaired by old-fashioned metal technology. S.D.

A75-46481 Laminated-metal composites. E. S. Wright and A. P. Levitt (U.S. Army, Army Materials and Mechanics Research Center, Watertown, Mass.) In *Composite materials Volume 4*. New York, Academic Press, Inc., 1974, p. 37-99.

40 refs.

A laminated-metal composite is referred to as a material consisting of two or more layers or laminate of different metals completely bonded to each other so as to produce a composite material whose resultant properties are much better than those of its constituents. The discussion covers the major metal-laminate fabrica-

tion methods, the properties of metal laminates, and materials engineering of these composites for specific applications. Fabrications methods include roll bonding, coextrusion, explosive welding, and brazing. The properties of these composites are discussed in terms of elasticity, yield strength and plasticity, fracture toughness, stress corrosion cracking, electrical conductivity, thermal conductivity, thermal flexibility, and corrosion and erosion resistance. Engineering criteria for selection and application of metal laminates are identified. S D

A75-46484 * Wire-reinforced superalloys R A Signorelli (NASA, Lewis Research Center, Cleveland, Ohio) In *Composite materials* Volume 4 New York, Academic Press, Inc., 1974, p 229 267 28 refs

The problems and progress encountered in developing refractory wire-reinforced superalloys for turbojet engine applications at operating temperature within 1000-1200 C are reviewed. Particular attention is given to the problem of the compatibility of the fiber-reinforcement wire and the superalloy matrix and to the means of improving composite properties. Fiber development is described, since fibers with better properties would result in better composite properties. Matrix composition is discussed in terms of its functions, namely to enhance compatibility and provide strength, oxidation protection, and ductility. Advantages and shortcomings of different fabrication techniques are revealed, and the current state of development of wire reinforced composites is outlined by indicating the properties achieved. Requirements for further development of the material and for application to engineering components are set forth. S D

A75-46545 An analysis of a self-balancing system for rigid rotors R S Sharp (Leeds University, Leeds, England) *Journal of Mechanical Engineering Science*, vol 17, Aug 1975, p 186 189 5 refs

An analysis is presented for the stability of the balanced condition of a system consisting of two balls running in a circular track attached to an unbalanced, single-plane rigid rotor supported on simple bearings. The results obtained indicate that the system should self-balance for a wide range of parameter values, however, instability can arise from lack of bearing damping, lack of ball damping, and from too high mass and radius ratios. The first of these insufficiencies promotes instability of the forward whirl of the rotor, while the other features favor ball mode instabilities. S D

A75-46548 Availability and propulsion J M Clarke (Noel Penny Turbines, Inc., England) and J H Horlock (Salford University, Salford, Lancs., England) *Journal of Mechanical Engineering Science*, vol 17, Aug 1975, p 223 232 9 refs

The first and second laws applied to steady flow systems are expressed in forms which emphasize the distinction between energy, which is conserved, and available energy, which is depleted in real processes. These forms are applied to propulsive systems using, as a velocity datum, the propulsion unit itself and, alternatively, the atmosphere at rest. The maximum thrust power obtainable from the combustion of the fuel is shown to be dependent on the composition, state and velocity of the fuel and also on the composition and state of the environment in which the unit works. An illustrative calculation of the losses in a turbojet engine in flight reveals that in this case 16.64 per cent of the fuel's available energy is obtained as thrust power, 54.25 per cent is rejected by the exhaust, 2.33 per cent is dissipated by aerodynamic losses and the remainder (26.78 per cent) is lost by combustion. Available-energy calculations are seen as providing a consistent framework within which losses can be compared within machines, between machines of different types for the same job and with perfection in the form of the completely reversible machine. (Author)

A75-46692 Payload without penalty - A suggestion for improving the take-off performance of fixed-wing V/STOL aircraft D R Taylor *Aeronautical Journal*, vol 79, Aug 1975, p 344 348

A ski jump and semiballistic flight technique is proposed as a means of improving safety and reducing space required for take-off, distance to a given screen height, and noise factors in STOL aircraft. A comparison is made between ski jump launch under three sets of conditions and a conventional short take-off using vectored thrust. Aspects of practical application pertaining to aircraft design and instrumentation and to airport size and layout are considered. C K D

A75-46693 Digital computing techniques in the manufacture and operation of engine management systems R J Davies (Lucas Aerospace, Ltd., Solihull, Warwick, England) *Aeronautical Journal*, vol 79, Aug 1975, p 349 353

The application of digital techniques and thick and thin film construction in the production of an electronic fuel control system is discussed. The use of computers to assist the design of electrical circuit layouts is described together with the technique of laser trimming. The test program is outlined. C K D

A75-46707 # Strategies for alleviating impact of aircraft noise A Kanafani (California, University, Berkeley, Calif.) and A Mogharabi (Pahlavi University, Shiraz, Iran) *ASCE, Transportation Engineering Journal*, vol 101, Nov 1975, p 657-668 9 refs

A methodology is described for evaluating alternative strategies for alleviating the impact of aircraft noise on communities located close to airports. The approach is to select, on the basis of a cost-effective analysis, an optimal strategy for noise reduction. A strategy is defined as a combination of noise reduction options exercised at various points in time within the analysis period. The effectiveness of a strategy is defined by the reduction in the total area exposed to a preselected noise level and is measured in square mile-years over a given time stream of aircraft operations. A general model for determining the optimal strategy is proposed. V P

A75-46713 Interactive computer graphics applied to the theoretical aircraft/store separation problem H R Spahr and H A Sumlin (Sandia Laboratories, Albuquerque, N Mex.) (*University of Colorado and Association for Computing Machinery, Conference on Computer Graphics and Interactive Techniques, Boulder, Colo., July 15-17, 1974*) *Computers and Graphics*, vol 1, Sept 1975, p 263-270 10 refs AEC-supported research

Recently, a computer program was developed which computes the theoretical trajectory of a store in the complex flow field after release from an aircraft flying at subsonic speeds. However, the engineer still had the exceptionally difficult problem of preparing the source and sink models which are part of the computer program input. Views of the interactive graphics console illustrate how an interactive graphics computer program (SOURCE) is used to prepare source and sink theoretical aerodynamic models for the aircraft fuselage, nacelles, fuel tanks, and store bodies. Use of this interactive graphics computer program reduces the calendar time required to develop a source and sink model from approximately 2 weeks to 1 h. This reduction in required calendar time permits theoretical store separation analyses to be conducted for a store in the early development program when the store shape is frequently being changed. (Author)

A75-46752 Anglo-French Symposium on the Effects of Stratospheric Aircraft, Oxford, England, September 24-26, 1974, Proceedings Volumes 1 & 2 Symposium sponsored by the Committee for Meteorological Effects of Stratospheric Aircraft Bracknell, Berks., England, Meteorological Office, 1975 Vol 1, 292 p, vol 2, 368 p In English and French

Papers are presented describing recent theoretical and experimental work on the chemistry of the stratosphere and its minor

constituents, the interaction of these constituents with aircraft exhaust jets, and long range effects of this interaction. Some of the topics covered include analysis of gas emissions of the Olympus engine in simulated flight, particle-size analysis of a jet engine wake, simultaneous measurements of NO and NO₂ in the stratosphere, NO detection by UV absorption of solar radiation, lidar measurements of stratospheric aerosols, a one-dimensional stratospheric chemical kinetics model, a time-dependent two-dimensional model of the general circulation of the stratosphere and mesosphere, dispersion of artificial clouds in the stratosphere, and the influence of variations in atmospheric ozone on some biological effects of solar UV radiation

P T H

A75-46753 # The COMESA research programme R J Murgatroyd In Anglo-French Symposium on the Effects of Stratospheric Aircraft, Oxford, England, September 24-26, 1974, Proceedings Volume 1 Bracknell, Berks, England, Meteorological Office, 1975, p 1-1 to 1-19

The paper outlines the chief problems concerning possible environmental effects resulting from the operation of large numbers of aircraft in the stratosphere. These problems are (1) ozone chemistry and solar UV penetration, (2) radiation balance and climatic effects, and (3) condensation trails and cloud formation. The COMESA research program has three main divisions: (1) measurements of stratospheric composition, (2) laboratory studies of basic processes, and (3) theoretical research including atmospheric modeling with large computers, climatological studies, and special investigations. Recent work on each of these aspects is outlined.

P T H

A75-46841 New wide-body transport plan evolving D E Fink *Aviation Week and Space Technology*, vol 103, Oct 13, 1975, p 22-25

A brief description is given of the proposed DC-X-200 wide body transport. It is noted that this twin-engine aircraft will have a capacity of 199 to 219 passengers and will be able to operate out of 8000-ft fields. Distinctive features of this vehicle include a super critical wing that will give it a cruise speed of Mach 0.82, a high-lift system, oversized turbofan engines, automatic reserve thrust, and extensive use of composites, especially in secondary structures.

F G M

A75-46843 Helicopter control concepts emerging K J Stein *Aviation Week and Space Technology*, vol 103, Oct 13, 1975, p 44, 45, 47-49, 51

Advanced system concepts aimed at enhancing control and stability as well as improving guidance and navigation capabilities of helicopters used in both military and commercial operations are discussed. It is noted that these concepts will aid in solving the dual problems of reducing pilot workload and improving the ability for remote-area instrument-flight-rules operations. Research efforts discussed include the VALT (VTOL approach and landing technology) program, hybrid fly-by-wire computerized control systems, the development of automatic flight and approach algorithms, precision altimetry, a 'turnaround' beacon system, cathode-ray tube displays, and fluidic airspeed sensors.

F G M

A75-46868 Rockwell proposes VTOL C-130 version C E Schneider *Aviation Week and Space Technology*, vol 103, Oct 6, 1975, p 34, 35, 37, 39

The incorporation of augmentor thrust wing technology in the Lockheed C-130 series transports is proposed for three mission modes: vertical takeoff to vertical landing, short takeoff to vertical landing, short takeoff to short landing. Augmentor wings and engines, flight controls, fuel systems and electrical, hydraulic, and pitch thruster systems would replace their conventional C-130 counterparts, and the horizontal tail would be modified. The C-130 fuselage, landing gear, and communication/navigation avionics are among the features to be retained. The thrust-augmented concept,

which produces lift up to 1.8 times the amount from engine exhaust air only is discussed, and control of airflow configuration by the adjustable diffuser flaps is described.

C K D

A75-46877 # Lift characteristics of small-aspect-ratio wings with longitudinal baffles (Nesushchie svoystva kryl'ev malogo udlineniia s prodol'nymi peregorodkami) A G Sakhno and V I Kholiavko *Samoletostroenie Tekhnika Vozdushnogo Flota*, no 37, 1975, p 7-12. In Russian.

The paper investigates the effect of longitudinal baffles on the lift force of a wing of small aspect ratio. The efficiency of the use of baffles is defined as the ratio of the lift force coefficient of a wing with baffles to that of a wing of similar design without baffles. General relations are obtained permitting estimates of the effect of various geometric parameters of the baffles and their arrangement along the span on the lift force of the wing.

P T H

A75-46878 # Effect of flow boundaries on the aerodynamic characteristics of a small-aspect-ratio wing (Vliianie granits potoka na aerodinamicheskie kharakteristiki kryla malogo udlineniia) V I Kholiavko and Iu F Usik *Samoletostroenie Tekhnika Vozdushnogo Flota*, no 37, 1975, p 12-16. In Russian.

Theoretical analysis of the motion of a thin flat wing of small aspect ratio in the bounded flow of an inviscid incompressible fluid. Solution is obtained on the basis of relations from the theory of slender bodies for the following cases of the motion of a wing of small-aspect ratio: (1) the wing is between two rigid horizontal surfaces, (2) the wing is between two free horizontal surfaces, and (3) the wing is between a lower rigid surface and an upper free surface.

P T H

A75-46880 # Effect of a radial gap on the characteristics of an axial compressor stage with small-aspect-ratio blades (Vliianie radial'nogo zazora na kharakteristiki osetovoi stupeni kompressora s lopatkami malogo udlineniia) A D Griga and V N Ershov *Samoletostroenie Tekhnika Vozdushnogo Flota*, no 37, 1975, p 22-26. In Russian.

Experimental characteristics (efficiency, pressure, terminal losses) were measured in single stage axial compressor stages as the size of the radial gap was varied. A formula is given for calculating the critical size of the radial gap corresponding to minimum terminal losses. It was found that in stages with small-aspect-ratio blades, the critical radial gap is larger than that for large-aspect-ratio blades, and amounts to 2% of the blade span.

P T H

A75-46881 # Investigation of variations of internal energy dissipation in working turbine blades of a gas-turbine engine during the process of their operation and fatigue tests (Issledovanie izmenenii vnutrennego rasseianiia energii v rabochikh lopatkakh turbin GTD v protsesse ikh ekspluatatsii i ustalostnykh ispytaniia) N A Iashkir, A S Tugarinov, V Kh Li, and B A Griaznov *Samoletostroenie Tekhnika Vozdushnogo Flota*, no 37, 1975, p 26-32. 10 refs. In Russian.

A75-46890 # Design of longitudinal elements made of composite materials with prescribed deflections of fuselage structures (Proektirovanie prodol'nykh elementov iz kompozitsionnykh materialov pri reglamentirovannykh progibakh korpusnykh aviakonstruktsii) V E Gaidachuk and Ia S Karpov *Samoletostroenie Tekhnika Vozdushnogo Flota*, no 37, 1975, p 73-80. In Russian.

A75-46891 # Determination of the optimal longitudinal assembly of the sparbox of a high aspect ratio straight wing (Opredelenie optimal'nogo prodol'nogo nabora kessonov priamogo kryla bol'shogo udlineniia) F G Iasinskii *Samoletostroenie Tekhnika Vozdushnogo Flota*, no 37, 1975, p 81-86. 5 refs. In Russian.

An algorithm is proposed for determining the optimal design parameters of a longitudinal assembly without recourse to time-consuming linear programming. Calculations for panels of various type may be carried out without changing the structure of the algorithm. The optimal versions of the cross section of a sparbox consisting of 5 upper and 5 lower panels are computed for various values of such parameters as the critical stress intensity factor, the bending moment, and the maximum panel stresses. The high effectiveness of the method makes it potentially useful in preliminary wing design and for determining the weight of the longitudinal structural assembly for various arrangements of the ribs, fuel tanks etc. C K D

A75-46931 Homebuilt experimental aircraft. Theory and practice, *Proceedings of the Symposium, Seattle, Wash., June 28, 1975*. Symposium sponsored by the American Institute of Aeronautics and Astronautics and Experimental Aircraft Association. Edited by W. E. Vasek. North Hollywood, Calif., Western Periodicals Co., 1975. 144 p. \$20.

The papers deal with recent advancements in small-aircraft aerodynamics and design. Topics include the design and aerodynamic characteristics of two advanced airfoils for general-aviation aircraft, variable camber wings, design criteria for sailwing aircraft, materials and processes for adhesive-bonded and composite aircraft structures, the Wiley engine, air-cushion landing systems, an operating prototype light amphibious surface-effect vehicle, the design and fabrication of a high-performance homebuilt jet aircraft, a flutter substantiation program for the Trigull 320 airplane, design concepts and modifications of simple airplanes designed for home building, canard designs for light aircraft, and the aerodynamics of very small aircraft. F G M

A75-46937 # Air-breathing jet engines for supersonic multi-regime aircraft (Vozdushno-reaktivnye dvigateli dlia sverkhzvukovykh mnogorezhimnykh samoletov). V. P. Kolodochkin. Moscow, Izdatel'stvo Mashinostroenie, 1975. 132 p. 10 refs. In Russian.

The book sets forth the basic characteristics of the course of the flow, thermodynamic, and throttle parameters during multiregime operation of the main types of turbojet engine used for supersonic aircraft. The engines considered are axial-flow single- or double spool engines, by-pass engines, and engines with afterburner. Methods of optimizing the parameters are set forth. P T H

A75-46971 # Continuous identification of a gas generator for a two-shaft turbine engine (Prubezna identifikace generatoru plynu dvouhridelove spalovaci turbiny). J. Salaba, V. Eck (Ceske Vysoke Ucení Technické, Prague, Czechoslovakia), J. Muller (JSV, Velešín, Czechoslovakia), and J. Andel (Tranzitní plynovod, Prague, Czechoslovakia). *Automatizace*, vol. 18, Aug. 1975, p. 214, 215. 5 refs. In Czech.

Three identification methods are applied to the construction of an adaptive model of a gas generator for a two shaft turboprop engine. The models are (1) a series-parallel adaptive model, (2) a parallel adaptive model, and (3) a model based on the principle of mathematical regression in recursive form. Models (1) and (2) are realized on an analog computer, while model (3) is realized on a digital computer. P T H

A75-47256 # The rolling up of a semi-infinite vortex sheet. D. W. Moore (Imperial College of Science and Technology, London, England). *Royal Society (London) Proceedings, Series A*, vol. 345, no. 1642, Sept. 30, 1975, p. 417-430. 9 refs.

The rolling up of a semiinfinite initially straight vortex sheet is studied analytically. In its initial state the circulation in the sheet increases as the square root of the distance from its edge. Previous investigations have asserted that the asymptotic form for the equation of the rolled up portion given by Kaden could be improved on by finding higher terms in a locally determined asymptotic expansion. This assertion is contested and it is suggested that the correction to Kaden cannot be found unless the shape of the whole

vortex sheet is known. The correction proposed renders the turns of the spiral slightly elliptical, the precise magnitude involving an integral over the entire vortex sheet. While a useful analytical solution cannot be found this way, it is suggested that the result would be useful in a numerical study. (Author)

A75-47276 Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, *Proceedings*. Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1975. 234 p. \$9.55.

Papers are presented dealing with the problem of designing aircraft engines with improved noise characteristics while at the same time giving consideration to the economical aspect of the problem. Some of the topics covered include second generation supersonic transport noise - performance dilemmas, designing for noise reduction, the airport viewpoint for reducing the impact of aircraft noise, the airline operational and regulatory viewpoint, and an economic analysis of aircraft noise reduction.

P T H

A75-47277 # Engine noise and economics. L. G. Dawson and T. D. Sills (Rolls-Royce /1971/, Ltd., Derby, England). In *Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft*, London, England, April 23, 24, 1975, *Proceedings*. London, Royal Aeronautical Society, 1975. 26 p.

It is argued that a 9 dB reduction below the present levels of aircraft engines of the RB 211 type will require major changes of operating procedures as well as significant improvements in sound absorbing materials. While such improvements are technically feasible, they are near the limit of what is economically reasonable. A 4 and one-half dB reduction in approach noise on the present RB 211 type engine should be feasible by detail modifications and improvements in the sound absorbing technology. At this noise level, the foot print areas of the Tri-Star type aircraft would be less than those of turbo-prop aircraft. If night curfews are rationally judged, aircraft of this noise standard should be able to operate on a round the clock basis. B J

A75-47278 # The economics and noise of subsonic aircraft. D. G. Brown (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England) and K. S. Lawson (British Airways Corp., Weybridge, Surrey, England). In *Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft*, London, England, April 23, 24, 1975, *Proceedings*. London, Royal Aeronautical Society, 1975. 22 p.

The interrelationships between aircraft noise and economic factors and their effect on the future pattern of civil air transport, are surveyed. The implementation of legislation providing for lower noise levels is discussed. Noise levels have already been significantly reduced by the use of high bypass ratio engines and by the adoption of revised operational techniques. Further reductions can be achieved by use of increased acoustic treatment of the engines airframe shielding, and the development of more advanced operating techniques. B J

A75-47279 # Insights into the second generation supersonic transport noise-performance dilemma. G. Cormery (Société Nationale Industrielle Aérospatiale, Paris, France). In *Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft*, London, England, April 23, 24, 1975, *Proceedings*. London, Royal Aeronautical Society, 1975. 20 p.

Design and operational criteria, based on Concorde experience, are presented, in this survey article, for improving the noise performance of supersonic transports. The various relevant parameters include engine containment, development of the nacelle arrangement, the use of fly by wire control, aerodynamic adaptation,

considering aeroelastic effects, improved fuels, the rational organization of air traffic control, the use of linear hold for reducing takeoff weight B J

A75-47280 # Designing for noise reduction. R P Gerend (Boeing Commercial Airplane Co., Renton, Wash.) and G S Schaerer (Boeing Co., Seattle, Wash.) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings

London, Royal Aeronautical Society, 1975 25 p 49

refs

The trend from the original pure jet engines to the high bypass engines has produced substantial reductions in community noise. The noise reductions have resulted from lower jet velocities, lower fan source noise and application of efficient acoustic linings. Further improvements are being hampered by lack of measurement techniques for isolating component noise and the fact that a number of noise components must all be reduced simultaneously to achieve meaningful improvement. Major noise sources: jet noise, turbine noise, core noise, and airframe noise, are pinpointed B J

A75-47281 Some research towards quieter aircraft F W Armstrong (National Gas Turbine Establishment, Farnborough, Hants., England) and J Williams (Royal Aircraft Establishment, Farnborough, Hants., England) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings

London, Royal Aeronautical Society, 1975 49 p 25

refs

A survey is presented of current research projects in the United Kingdom for aircraft noise reduction. The development of anechoic chambers for engine noise tests is discussed. Ground based facilities with flight simulation are described. Some current research and design topics are discussed, among which are engine exhaust noise, engine sound absorption, airframe shielding of engine noise, and airframe self noise. Computer procedures for noise-optimal aircraft design are described B J

A75-47284 # A United States airline operational and regulatory viewpoint F W Kolk (American Airlines, Inc., New York, N.Y.) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings

London, Royal Aeronautical Society, 1975 17 p

A survey is presented of recent U.S. government legislation and FAA regulations relating to aircraft noise reduction, and their effect on airline operations. A review of sound absorption technology is given. Various design and cost criteria are presented, with emphasis on takeoff noise. The specific noise annoyance factor and its determination are discussed B J

A75-47285 # Economic analysis of aircraft noise reduction. C R Foster (FAA, Washington, D.C.) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings

London, Royal Aeronautical Society, 1975 13 p

A cost analysis is presented of aircraft noise control programs, spurred by the Noise Control Act of 1972 and by recent FAA regulations. Over 200 million dollars have been spent for: (1) information about the psychoacoustic effects of noise, (2) noise prediction models, (3) noise measurement techniques, (4) basic studies of noise generation and propagation, (5) sound absorbing material, (6) flight-worthy engine nacelles, and (7) operational noise-reduction procedures. The cost effectiveness of the SAM retrofit program is discussed B J

A75-47286 # The philosophy of noise reduction K W Smith (Department of Industry, London, England) In Symposium

on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings

London, Royal Aeronautical Society, 1975 18 p

A practical philosophy for aircraft noise reduction in the future is developed. The past history of noise reduction is briefly mentioned. Potential solutions for reducing noise by optimizing aircraft design, and operating techniques, are given. The retrofit program is described. The nature of certification schemes is discussed B J

A75-47288 Measurements of external sound from light propeller-driven aircraft G J J Ruijgrok (Delft, Technische Hogeschool, Delft, Netherlands) *Delft Progress Report, Series C - Mechanical and Aeronautical Engineering and Shipbuilding*, vol 1, Sept 1975, p 84 92 7 refs

This paper briefly describes the measurement techniques, the calculation procedure and the first results of an experimental research program to investigate the external sound radiation by light propeller-driven aircraft (general aviation aircraft). As basic quantities of the sound source, power watt level spectra and directional patterns are presented for three different light aircraft types under certain flight conditions (Author)

A75-47316 Aerospace sandwich materials V (Materiaux sandwich aérospatiaux V) S Dzalba-Lydis (Société Nationale Industrielle Aérospatiale, Paris, France) *Materiaux et Techniques*, vol 63, Aug-Sept 1975, p 327-336 18 refs In French

The structural resistances of various sandwich materials submitted to compression or to static or dynamic bending are compared among themselves and with conventionally produced structures. Use of sandwich materials as soundproofing is discussed. A general comparison of production costs using sandwich materials and conventional materials is made, and costs per square meter of several sandwich honeycomb structures are given. Examples of specific applications of sandwich materials in aircraft interiors, exteriors, and propulsion systems are outlined C K D

A75-47419 * # Bringing wings of change - NASA's airfoil research program P K Pierpont (NASA, Langley Research Center, Subsonic Transonic Aerodynamics Div., Hampton, Va.) *Astronautics and Aeronautics*, vol 13, Oct 1975, p 20-27 18 refs

A review is presented of progress in attaining technical objectives in three areas of semiautomatic airfoil development: software, hardware, and applications. Software objectives seek improved mathematical models and computer codes for flow analysis and design optimization for a variety of conditions. The 17 step iterative computer model used in designing the GA (W) 1 airfoil is effective but not yet fully automated, with present methods only single point computer optimization is possible. Hardware objectives calling for improvement in test facilities and techniques are met in part by the introduction of the Langley (F-3C) wind tunnel for independent evaluation of transonic Mach number and Reynolds effects up to 12-16 million, and by a two-dimensional test section for the Langley 1/3 transonic cryogenic tunnel which will extend the Reynolds number to 50 million. The current status of low-speed, thin, and rotorcraft airfoil development programs is discussed

C K D

A75-47438 # The experimental investigation of some characteristics of the supersonic flow around delta wings (Eksperimental'noe issledovanie nekotorykh osobennostei sverkhzvukovogo obtekania V-obraznykh kryl'ev) M A Zubin and N A Ostapenko (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, July-Aug 1975, p 130-135 11 refs In Russian

A flow visualization study was conducted in a hypersonic wind tunnel on the conical flow around two delta wing models. The supersonic flow structure around the windward and leeward sides of the wings was investigated. The experiment was twofold to

determine the distribution of pressure coefficients and the position of the runoff line, and to observe the shock layer attached to the leading edge of the wing
B J

A75-47477 # Effects of porosity, density and reinforcement parameters on the supersonic rain erosion of ceramic materials G F Schmitt, Jr (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) *American Ceramic Society, Annual Meeting and Exposition, 77th, Washington, D C, May 3-8, 1975, Paper 30 p*

The erosion behavior of ceramic materials in a supersonic rain environment is described. Bulk ceramic materials such as fused silica and boron nitride erode according to 4.5 to 5.0 power of the velocity. Very high strength ceramics such as alumina, beryllia, and Pyroceram fail by catastrophic fracture in the same speed regime. Reaction-sintered and hot-pressed silicon nitride exhibit excellent promise for supersonic erosion resistance up to Mach 5.0. Fiber reinforced ceramics such as quartz silica in orthogonal 3-D and angle interlock 3-D constructions undergo severe erosion but retain structural ability in contrast to severe fracture of monolithic ceramics. An expression is provided for the erosion rate velocity-impingement angle dependence for supersonic rain encounter at velocities from 1500 to 5500 ft/sec
(Author)

A75-47478 # Thermal fatigue of coated superalloys T E Strangman and S W Hopkins *American Ceramic Society, Annual Meeting and Exposition, 77th, Washington, D C, May 3-8, 1975, Paper 16 p*

The penetration of a coating crack into the base metal has been analyzed with the aid of a fracture mechanics model. Differential thermal expansion between the coating and substrate, coating thickness, and the coating-substrate elastic modulus ratio are shown to significantly affect the rate of crack propagation into the substrate. From a thermal fatigue standpoint, the results obtained with this model indicate that a significant incentive exists to develop coatings which are thin and provide small compressive thermal expansion mismatch strains in the coating on cooling
(Author)

A75-47479 Wing aeroelastic structural analysis applied to the study of fuel-conserving CTOL transports R D Anderson and B Giridharadas (Boeing Co., Seattle, Wash.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1040 27 p 6 refs*

The impact on wing weight due to variations in wing geometry and cruise Mach number was studied. Attention was also given to the impact on the aircraft weight, fuel usage, economics, and noise due to variations in wing geometry and cruise Mach number while maintaining constant payload/range performance. Selection of a baseline wing was made on the basis of the results obtained in a wing geometry investigation. Details of the approach used in the studies are discussed, taking into account aspect ratio studies and sweep-thickness studies
G R

A75-47480 Methods for the determination of gross weight B Saelman (Lockheed-California Co., Burbank, Calif.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1041 43 p 7 refs*

One of the considered methods makes use of statistical plots of gross weight versus rational functions of the significant parameters affecting gross weight. In connection with another method equations are presented for the minimum speed, level flight, absolute ceiling, and gross weight. In a third method the growth factor is applied to obtain the gross weight of a configuration which is derived from base design, the gross weight of which is known. A fourth method employs the concept of grouping weights of the various components of the aircraft into primary functional categories, consisting of payload accommodations, lift and ground requirements, propulsion system, and required fuel
G R

A75-47481 Payoffs from active controls technology applications - Transport aircraft D P Marsh (Douglas Aircraft Co., Long Beach, Calif.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1042 12 p*

A comprehensive mass properties analyses process is essential in determining reliable payoffs for reduced static stability (RSS) and load alleviation and mode suppression (LAMS). This process is discussed as it applies to advance design studies relating to the application of active controls to transport aircraft. Reference is made to the Douglas mass properties estimation system (MAPES) which is a computer program for transport aircraft weight estimation, and is very adaptable to active controls applications. Weight effects to structural components resulting from the application of RSS and LAMS are discussed, as are systems implications. Payoffs are discussed in terms of vehicle range, vehicle size, and increased payload
(Author)

A75-47482 Fatigue and damage tolerance effects on preliminary design wing weights R E Stephens (Lockheed-Georgia Co., Marietta, Ga.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1043 20 p* Contract No. F33615-72-C-2165

The purpose of this study is to assess the effect of current design criteria and advanced technology on an existing structure. The structure chosen for the study was the C-141 inner wing box. The design criteria include the new fatigue and damage tolerance criteria which will probably be required on any new Air Force aircraft. The advanced technology includes new materials and new structural configurations. Two alternate box configurations are presented showing the effects of material properties and cover configurations on the wing weight. Prediction of some trends based on these results is presented
(Author)

A75-47483 # Allowable stress estimation methods for preliminary design weight prediction L E Lewis and R S Saint John (LTV Aerospace Corp., Vought Systems Div., Dallas, Tex.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1044 59 p 11 refs*

This paper presents development of allowable stress estimation methods specifically tailored to preliminary design weight prediction. The paper presents a unique analytical technique for projecting test results to cover a large variety of material/temperature combinations, including composite materials. It is shown how this approach overcomes inaccuracies and limitations associated with stress rationing techniques by providing accountability for material strength limitations such as plasticity. Methods for compression, tension/fatigue and shear are developed. Discussions are limited to primary wing, tail and body structure. Method application examples are included in the paper
(Author)

A75-47490 Rotorcraft technology 1985-1990 A technology assessment and review of engineering developments in the design of rotorcraft and its effect on the weight engineering discipline. E G Lilley (Bell Helicopter Co., Fort Worth, Tex.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1055 23 p 10 refs*

An overall projection of structures, subsystems, and equipment for rotorcraft is presented, with special consideration of areas where major advances in the state-of-the-art are expected, and of the effect of these advances on the role of the weight engineer. Both logical extrapolations and complete departures from known technology are discussed
C K D

A75-47491 The challenge of weight and balance control and design-to-cost for YC-14 prototype development J G Hutton (Boeing Aerospace Co., Seattle, Wash.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1056 16 p*

Development of the Boeing YC 14 STOL aircraft to meet program goals of airlift capability of a 27,000 lb payload in and out of a 2000 ft undeveloped field and a 400 nm radius of operation is discussed. Design characteristics of the aircraft, including engine placement, flight control system, and empennage are given. The design to cost approach in each of the major components of the YC 14 prototype (propulsion system, wing, empennage, and fuselage) is detailed, and the design work package team concept for rapid dissemination of accurate information early in the design process, is discussed. Problems of planning for weight and balance control are considered. C K D

A75-47497 Safety/reliability and their impact on aerospace vehicle weight and cost. N E Tipton (General Dynamics Corp., Convair Div., San Diego, Calif.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1067* 10 p

The objective of this paper is to familiarize weight engineers with the powerful influence that reliability and safety requirements can have on the weight and cost of aerospace vehicles. Results of typical reliability/safety analyses are used to illustrate the relationships between various levels of potential reliability/safety achievement and the associated program costs. Examples are used to illustrate how the safety requirements are first integrated into the design and how implementation of safety requirements can enhance, or detract from, system reliability. Once the safety requirements have been provided for, system reliability is systematically increased, at increasing cost and weight, until an optimum level is reached that is consistent with minimum total program costs. The manner in which this optimization is achieved is described through the development of typical reliability/weight/cost analyses. (Author)

A75-47498 Will design-to-cost work over the long haul. E H Johnson and R H Nansen (Boeing Design-to-Cost Laboratory, Seattle, Wash.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1068* 23 p

Design-to-cost is now a popular government procurement discipline by means of which future cost effective weapon systems may be acquired. The present paper relates design-to-cost philosophies with real world problems and establishes clear-cut mutual industry/government responsibilities. Significant problem areas which require resolution by both government and industry are outlined. V P

A75-47499 An integrated approach to value engineering and weight engineering in the Design-To-Cost environment. E G Lilley (Bell Helicopter Co., Fort Worth, Tex.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1069* 25 p

The objectives of design-to-cost are discussed, and the role of the weight engineer in solving the total problem of engineering cost control is delineated. The difference between the Engineering Cost Control Group and the Design-to-Cost team is explained with specific references to development of Bell Helicopter's commercial Model 222 to meet target costs and weights. C K D

A75-47500 The integrated team - Key to implementing design-to-cost. R E Johnston (General Dynamics Corp., Convair Div., San Diego, Calif.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1070* 15 p. 11 refs

A management system is described which appears to provide the framework for successful design-to-cost implementation based on the integrated team approach. Using an integrated project team organization, product design and system development activities are continuously evaluated against cost requirements with emphasis equal to that placed on technical requirements. The design-to-cost plan features evolution of the product design to specified cost targets in discretely planned controlled and fully traceable steps. V P

A75-47501 * A parametric determination of transport aircraft price. J L Anderson (NASA, Ames Research Center, Moffett Field, Calif.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1071* 35 p. 11 refs

Cost per unit weight and other airframe and engine cost relations are given. Power equations representing these relations are presented for six airplane groups: general aircraft, turboprop transports, small jet transports, conventional jet transports, wide-body transports, supersonic transports, and for reciprocating, turbo-shaft, and turbothrust engines. Market prices calculated for a number of aircraft by use of the equations together with the aircraft characteristics are in reasonably good agreement with actual prices. Such price analyses are of value in the assessment of new aircraft devices and designs and potential research and development programs. C K D

A75-47502 An approach to integrated cost/weight design methodology. M E Talley and R N Mueller (USAF, Flight Dynamics Laboratory, Wright Patterson AFB, Ohio) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1072* 6 p. 7 refs

The current emphasis on cost analysis and the design-to-cost philosophy within DoD has created an immediate need for analytical methods which can rapidly and accurately estimate the cost of a specific aircraft design. This paper discusses the detail which can and will be required in preliminary design studies to achieve sensitivity to the cost driving design parameters. Some limited experience with new D-T-C methods has revealed that implementation of the system for D-T-C programs will require (1) a common format for cost and weight data, (2) manufacturing analysis suitable to preliminary design, (3) assessment of damage tolerance criteria on cost and weight, and (4) detailed tracking of cost data in advance technology programs. (Author)

A75-47503 STAN developments and applications. B J Hawkins (Fairchild Camera and Instrument Corp., Fairchild Industrial Products Div., Commack, N Y) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1073* 16 p

STAN (a registered trademark of Fairchild Camera and Instrument Corp.) is a system for determining aircraft takeoff gross weight and center of gravity. It has been in operation since 1965. About 300 aircraft are currently equipped with the STAN system, including such aircraft as the 707, DC-8, 737, DC-9, L-188, Falcon, Gulfstream II, KC-135 and several other types. The basic STAN concept of using pressure transducers to measure strut pressures as a function of aircraft weight is described. V P

A75-47504 Digital computer applications to weight and balance analysis. C S Walters (Aviation Technology, Inc., Plantation, Fla.) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash., May 5-7, 1975, Paper 1075* 6 p

The Aviation Technology, Incorporated computer products described are shown to provide a more rapid, positive sequence, precise computation of critical preflight and flight operating data for aircraft than is presently available. The computation requirements discussed are applicable to all aircraft, including high performance heavy aircraft, such as transport/cargo carriers, for which precise computation is particularly critical. By use of microprogramming and application of modern technology in microcircuitry, the product result is a digital, sequenced controlled and programmed computer intended for the solution of aircraft weight and balance and inflight engineering calculations. V P

A75-47505 Theoretical versus actual seating patterns in wide bodied aircraft. T L Shuler (Boeing Commercial Airplane Co.,

Seattle, Wash) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash , May 5-7, 1975, Paper 1080* 15 p

Two sets of TWA data from one Boeing 747 operator are analyzed in an attempt to answer, or at least locate the problem areas of questions regarding theoretical and actual seating patterns in wide-bodied aircraft. Particular attention is given to the following questions: Where do people tend to sit in wide-bodied aircraft? Do present day mathematical models used for seating pattern developed for first generation jet aircraft apply to double aisles variable length multi-service zoned aircraft? And is the sum of individual zone seating variations established by these models adequate for the operational allowance curtailing the certified center of gravity limits? V P

A75-47506 The weight engineer in engineering flight test R B Pemberton (Boeing Co., Seattle, Wash) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash , May 5-7, 1975, Paper 1081* 12 p

The weight engineer's role in flight test development and certification demonstration is discussed, and the means employed (and the function each plays) in the overall development and certification program are described. The pre-rollout requirements in design and calibration of water ballast and fuel systems are examined, along with the responsibilities of maintaining accurate weight records. The weight engineer's role as an important member of the test team is outlined. V P

A75-47507 * *Aircraft concepts for advanced short haul systems* T L Galloway (NASA, Ames Research Center, Moffett Field, Calif) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash , May 5-7, 1975, Paper 1085* 30 p 10 refs

The results of recent NASA-sponsored high density and medium-density short-haul (less than 500 miles) air transportation systems studies are summarized. Trends in vehicle characteristics, in particular of RTOL and STOL concepts, are noted, and their economic suitability and impact on the community are examined. V P

A75-47508 *Calibration of On-Board Weight and Balance Systems* B H Shapiro (BLH Electronics, Inc., Waltham, Mass) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash , May 5-7, 1975, Paper 1086* 15 p

The objective of this paper is to present an overview of the various techniques available for calibrating On-Board Weight and Balance Systems. The techniques, as presented, represent a broad spectrum of weighing approaches, some of which are no longer in common usage but are included for over-all perspective. The major emphasis is on the use of weighing scales, particularly the BLH MEWS System, which uniquely lends itself to the calibration of On-Board Weight and Balance Systems. Since the system was specifically designed to determine weight and center of gravity of aircraft, it very readily lends itself to the intended calibration function. The MEWS system is described in detail to acquaint the reader with its characteristics as well as the best way of using this equipment for its intended function. (Author)

A75-47509 *Weight contribution to fuel conservation for terminal area compatible aircraft* G W Hanks (Boeing Co., Seattle, Wash) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash , May 5-7, 1975, Paper 1091* 25 p 6 refs

The contribution to reductions in fuel consumption by potential weight characteristics of advanced aircraft are considered, and trades between weight reduction versus increased aerodynamic and operating efficiency are discussed. Direct reductions in fuel use may be obtained by application of advanced technology in structure and airfoils, proper engine choice, and revised environmental control features. Weight penalties involved in wing planform optimization are

countered by increased aerodynamic efficiency. Results of studies of an M = 0.80, 200 passenger, 5556 km design incorporating advanced structure, airfoils, and propulsion show 21.6% reductions in operational empty weight and takeoff gross weight as compared to a conventional design. Features for reduction of congestion and emissions offer fuel reduction potential, noise reduction devices carry weight and fuel-use penalties. Implementation of the described fuel reduction approaches will yield an estimated 25% reduction in fuel consumption. C K D

A75-47510 *A loadability comparison of the L-1011 and DC-10-10* R D Maxwell (Delta Air Lines, Inc., Atlanta, Ga) *Society of Allied Weight Engineers, Annual Conference, 34th, Seattle, Wash , May 5-7, 1975, Paper 1094* 14 p

A comparison between the loadability of the McDonnell Douglas DC-10-10 and Lockheed L-1011 TriStar (each of which is a 250-seat wide-body trijet with similar dimensions and weights) shows that the DC 10 has a decided advantage in empty weight, which is the heart of good weight and balance characteristics. It also has a greater freight hauling flexibility, because a 3 500-pound container can be loaded in any or all locations. V P

A75-47514 # *Liner cooling of an aircraft gas turbine combustor* T Aiba (National Aerospace Laboratory, Tokyo, Japan) *ASME, AICHE, CSChE, and CSME, Heat Transfer Conference, San Francisco, Calif , Aug 11-13, 1975, ASME Paper 75-HT-3* 10 p 15 refs. Members, \$1.00, nonmembers, \$3.00

The present paper is concerned with the problems of flame radiation, liner temperature and film cooling of an aircraft gas turbine combustor at pressurized conditions. Flame radiation in the combustor was treated with the idea of radiosity, using the assumptions of representative gas temperature, gray gas, several isothermal surfaces, etc. Liner temperature was calculated for an annular-type combustor from the heat balance of flame radiation and cooling heat flux given by convective and film cooling. The film cooling for the combustor was discussed based on the length of potential core given directly after the cooling slot. The result showed a rapid increase of liner temperature up to about 10 atm and a gradual increase above the pressure. The height of the cooling slot was determined considering the number of slots, coolant flow rate and cooling capacity. Application of the present method showed a confirmative result. (Author)

A75-47536 # *Properties of Mach reflection in the interaction between shock waves and a stationary wedge* (Svoistva makhovskogo otrazheniia pri vzaimodeistvii udarnykh voln s nepodvizhnym klinom) A N Semenov and M P Syshchikova *Fizika Goreniia i Vzryva*, vol 11, July-Aug 1975, p 596-608 24 refs. In Russian

An attempt is made to analyze and generalize existing data from a unified point of view which is based on an interpretation of Mach reflection as the result of an interaction between two simultaneous processes: oblique reflection of an incident shock wave from the surface of a wedge, and the flow of a gas behind the incident wave past the bow of the wedge. The results of experiments carried out with a 45-degree wedge are illustrated and discussed. V P

A75-47575 *No-melt welding* R B Aronson *Machine Design*, vol 47, Oct 16, 1975, p 128-133

The current status of knowledge regarding the definition, process factors, welding techniques, advantages, and applications of solid-state welding for joining high-strength and exotic metal is reviewed. Solid-state welding is defined as a process in which the contacting surfaces of two parts are joined when their atoms mingle under the action of pressure and heat which is below the melting point of the materials. Process factors such as time, heat, and pressure are discussed along with surface finish, cleanliness and protective atmosphere. Many welding techniques are outlined,

including hot press diffusion welding, roll welding, air diffusion welding, and inertia welding. Major advantages of solid-state welding are that the metallurgical properties of the base materials can be fully preserved in the joint, that dissimilar materials can be joined, that joints are strain-free, and that structures with intricate channels or cavities can be manufactured in conjunction with desired heat treatment. Recent progress in diffusion welding of aircraft components with reliable weld joint quality is discussed. S D

A75-47576 United States-Japan Seminar on Combined Nonlinear and Linear Fracture Mechanics - Applications to Modern Engineering Structures, Sendai, Japan, August 12-16, 1974, Proceedings Seminar sponsored by the Japan Society for the Promotion of Science and National Science Foundation. *Engineering Fracture Mechanics*, vol 7, Sept 1975 253 p

This collection of papers is concerned with the major aspects of the nonlinear fracture mechanics theories, the results and potentials of combined microscopic and macroscopic viewpoints of fracture mechanics, and problems regarding the application of these combined research results to modern engineering structure in as much a unified manner as possible. The basic limitation of linear elastic fracture mechanics (LEFM) is its intrinsic restriction to cases of small crack-tip plastic deformation prior to fracture. Most research efforts at broadening the range of applicability of fracture mechanics to include significant nonelastic behavior have been affected along two main directions: incorporation (from a macroscopic standpoint) of crack-tip plasticity and slow crack growth into a nonlinear theory of fracture mechanics, and correlation of combined microscopic and macroscopic fracture mechanics considerations within the general context of LEFM. Fracture mechanics applications in aircraft structural safety as well as in ship design, construction, and operation are discussed.

S D

A75-47591 Application of fracture mechanics to aircraft structural safety. H. A. Wood (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). (*Japan Society for the Promotion of Science and National Science Foundation, United States-Japan Seminar on Combined Nonlinear and Linear Fracture Mechanics - Applications to Modern Engineering Structures, Sendai, Japan, Aug 12-16, 1974*) *Engineering Fracture Mechanics*, vol 7, Sept 1975, p 557-564. 8 refs.

Design requirements have been developed to insure structural safety for current and future USAF aircraft. New structure is assumed to be flawed. Materials, stress levels and structural arrangements are chosen so as to prevent damage from growing to catastrophic size prior to detection. Safety from damage induced through service usage is insured by providing inspection capability and by meeting specific residual strength and safe crack growth requirements. Compliance with these requirements implies the capability to predict growth rates under complex loadings and to calculate the fracture strength of structures fabricated of relatively tough materials which may exhibit large amounts of crack tip plasticity prior to failure. This paper reviews significant factors leading to the development of damage tolerance criteria and illustrates the role of fracture mechanics in the analysis and testing aspects necessary to satisfy these requirements. (Author)

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STAR ENTRIES

N75-32008 Ohio State Univ., Columbus
AN ANALYSIS OF HEAT TRANSFER ON A JOUKOWSKI AIRFOIL WITH SEPARATION AND REATTACHMENT Ph D Thesis

Lucien Louis Debruge 1975 118 p
 Avail Univ Microfilms Order No 75-19428

An analytical method depicting a two-dimensional incompressible steady state flow over the convex side of a Joukowski airfoil on which a large separation bubble has developed is formulated. The vortex strength generating the flow recirculation inside the bubble and the perturbation of the inviscid velocity distribution outside the separation bubble is such that the calculated separation of the boundary layer on the cylinder in cross flow occurs in the vicinity of the experimentally observed separation at a Reynolds number of 10. The Bachelor representation of a recirculating confined flow at high Reynolds numbers is adopted for the analysis of the flow in the separation bubble. With the vorticity and the entropy of the rotating core assumed constant, the heat transfer coefficient on the closed streamline representing the separation bubble contour is calculated for constant wall temperature and a Prandtl number of 0.71

Dissert Abstr

N75-32010 Pennsylvania State Univ., University Park
UNSTEADY VORTEX LATTICE TECHNIQUES APPLIED TO WAKE FORMATION AND PERFORMANCE OF THE STATICALLY THRUSTING PROPELLER Ph D Thesis

Gerald Forrest Hall 1974 199 p
 Avail Univ Microfilms Order No 75-19764

The application of vortex lattice techniques to the problem of describing the aerodynamics and performance of statically thrusting propellers was studied. A numerical lifting surface theory to predict the aerodynamic forces and power, including corrections for viscous effects was performed. The lifting surface was replaced by a twisted flat plate which reflects the radial twist distribution of the propeller blades. The chordwise and spanwise loading was then modelled by bound vortices fixed to the flat plate surface. Particular attention was paid to the formation of the wake. The wake was generated in time and allowed to deform under its own self-induced velocity field as the motion of the propeller progressed. Thus the time history of its shape as well as the inflow at the blades was known

Dissert Abstr

N75-32011 Princeton Univ. N.J.
ANALYTICAL STUDY OF THE AERODYNAMIC COUPLING OF HELICOPTER ROTOR BLADES IN HOVER FLIGHT Ph D Thesis

Petrus Antonius Maria Spierings 1974 120 p
 Avail Univ Microfilms Order No 75-20665

The strong tip vortices of modern rotary wing aircraft cause nonuniform inflow at the rotor plane. Rotor blades which flap in this velocity field experience rapidly changing aerodynamic moments about the blade root. The primary contributor to this induced nonlinear moment is the tip vortex of the preceding blade. The rotor wake interaction was studied with an approximate analytical wake model. The aerodynamic moment induced by the wake about the blade root of a single blade is derived and the effects of stall and blade tip vortex core intersection is determined. It is found that multi-equilibrium flapping angles can exist because of the nonlinear aerodynamic moment. For a

rotor, it is established that the wake can couple the blades aerodynamically. The performance of aerodynamically coupled rotor blades agrees with experiments. The stability of the rotor system is shown to depend on blade number, blade loading, Mach number and Lock number. The destabilization phenomena of the aerodynamically coupled rotor is blade flapping at subharmonic frequencies

Dissert Abstr

N75-32012# National Aerospace Lab., Tokyo (Japan)
PRESSURE DISTRIBUTIONS ON THE SURFACE OF EXTERNALLY-BLOWN FLAP

Norio Inumaru, Kiyomi Kitamura, and Hitoshi Takahashi. Mar 1975 22 p. refs. In JAPANESE ENGLISH summary
 (NAL-TR-410) Avail NTIS HC \$3.25

Wind tunnel measurements of a jet engine model and a two dimensional wing model equipped with the pressure orifices on the airfoil contour of its mid span were made to determine surface pressure distribution on externally blown flap (EBF) configurations. A fan jet engine model was placed in various angles and positions relative to the wing and was traversed along the wing span across the free stream. Surface pressure distribution on the wing model was measured to investigate aerodynamic interference between the wing and the engine. Special features of pressure distribution corresponding to each type of EBF classified were revealed. An augmented lift was supplied by the integration of surface pressure. A discussion is presented on the EBF lift augmentation in comparison with the deflected slipstream concept. Effects of wing-sweep on the surface pressure were also examined using the measurements. Author

N75-32014# Advisory Group for Aerospace Research and Development, Paris (France)

RECOMMENDED PROCEDURES FOR PROCESSING ACCELERATION DATA OBTAINED BY AIRCRAFT DURING ATMOSPHERIC TURBULENCE ENCOUNTER

John C. Houbolt (Aeron. Res. Assoc. of Princeton, Inc., N.J.) Jul 1975 15 p. refs.
 (AGARD-R-631) Avail NTIS HC \$3.25

Recommendations are given for processing vertical acceleration data obtained during turbulence encounter of aircraft in service operation to obtain useful structural design information for gust encounter. Specific data reduction procedures are recommended. A key point in the recommendations is that all data processing be done on a consistent basis. Charts and steps for data reduction are presented to achieve this goal. Author

N75-32015# Advisory Group for Aerospace Research and Development, Paris (France)

MATHEMATICAL MODELING AND RESPONSE EVALUATION FOR THE FLUCTUATING PRESSURES OF AIRCRAFT BUFFETING

John C. Houbolt (Aeron. Res. Assoc. of Princeton, Inc., N.J.) Jul 1975 14 p.
 (AGARD-R-630) Avail NTIS HC \$3.25

The mathematical modeling used to describe the pressure fluctuations in various turbulent flow problems is reviewed. Attention is focused mainly on statistical descriptions such as are involved in power spectral approaches. These models were used as building blocks to synthesize a mathematical model describing the turbulent pressure fluctuations during buffeting of an airplane wing. Means for evaluating the dynamic response of the structure due to the buffeting forces were developed. An example treatment shows that the dynamic response may be an appreciable percent of an associated reference static deflection. It is recommended that a series of controlled buffet tests be made to check on the validity of the equations, and to establish their parameters. Author

N75-32016*# National Aeronautics and Space Administration
 Ames Research Center, Moffett Field, Calif

WIND TUNNEL INVESTIGATION OF A LARGE-SCALE UPPER SURFACE BLOWN-FLAP MODEL HAVING FOUR ENGINES

Kiyoshi Aoyagi, Michael D. Falarski, and David G. Koenig. Jul 1975 69 p. refs. Prepared in cooperation with Army Air Mobility

R and D Lab, Moffett Field, Calif
(NASA-TM-X-62419, A-8003) Avail NTIS HC \$4 25 CSDL 01A

Investigations were conducted in the Ames 40- by 80-Foot Wind Tunnel to determine the aerodynamic characteristics of a large-scale subsonic jet transport model with an upper surface blown flap system. The model had a 25 deg swept wing of aspect ratio 7.28 and four turbofan engines. The lift of the flap system was augmented by turning the turbofan exhaust over the Coanda surface. Results were obtained for several flap deflections with several wing leading-edge configurations at jet momentum coefficients from 0 to 4.0. Three-component longitudinal data are presented with four engines operating. In addition, longitudinal and lateral data are presented with an engine out. The maximum lift and stall angle of the four engine model were lower than those obtained with a two engine model that was previously investigated. The addition of the outboard nacelles had an adverse effect on these values. Efforts to improve these values were successful. A maximum lift of 8.8 at an angle-of-attack of 27 deg was obtained with a jet thrust coefficient of 2 for the landing flap configuration. Author

N75-32017*# Georgia Inst of Tech, Atlanta
OPTIMUM PERFORMANCE AND POTENTIAL FLOW FIELD OF HOVERING ROTORS Final Report

J C Wu and R K Sigman 24 Sep 1975 93 p refs Sponsored in part by Army
(Contract NAS2-6340)
(NASA-CR-137705) Avail NTIS HC \$4 75 CSDL 01A

Studies of rotor and propeller performance and induced potential flow fields were made on the basis of a rotating actuator disk concept, with special emphasis is placed on rotors hovering out of ground effect. A new theory for the optimum performance of rotors hovering OGE was developed. An extended theory for the optimum performance of rotors and propellers in axial motion is presented. Numerical results are presented for the optimum distributions of blade-bound circulation together with axial inflow and ultimate wake velocities for the hovering rotor over the range of thrust coefficient of interest in rotorcraft applications. Results of the optimum performance study show that improvements made possible by the present performance theory, which fully account for the effects of slipstream rotation is important to the optimum circulation as well as to the power and the thrust requirements of the rotor in the higher thrust coefficient range. A number of explicit formulae useful in computing rotor and propeller induced flows are presented for stream functions and velocities due to distributions of circular vortices over axisymmetric surfaces. Author

N75-32020*# Flow Research, Inc., Kent Wash
THE SIMULATION OF TURBULENT BOUNDARY LAYER SEPARATION ON MULTI-ELEMENT INFINITE SWEEP WINGS

F A Dvorak and E W Geller Mar 1975 21 p refs
(Contract NAS2-7048)
(NASA-CR-137694, Rept-70) Avail NTIS HC \$3 25 CSDL 01A

An improved method of simulating the effect of flow separation on potential flow over two-dimensional and infinite swept multi-element wings was developed. Two types of flow separation are considered at the wing trailing edge, and at the cove region between the main wing and the flap. Potential flow is assumed outside the boundary layer and the separated wake. A previously obtained computer program (VIP) is modified by matching the outflow distribution for the potential flow such that the potential flow part of the real flow is duplicated and the results agree with the experimental observations. Results are given for the NACA 2412 airfoil. Iterative drag calculations are presented. Y J A

N75-32022*# Avco Corp, Wilmington, Mass Systems Div
ANALYSIS OF HELICOPTER ROTOR BLADE TORSIONAL OSCILLATIONS DUE TO STALL Final Report

Peter Crimi Washington NASA Sep 1975 58 p refs
(Contract NAS1-12853)
(NASA-CR-2573) Avail NTIS HC \$4 25 CSDL 01A

An analysis of stall-induced helicopter rotor blade torsional oscillations was carried out, the primary objectives being to predict the onset and severity of the oscillations and their relationship to aircraft and blade parameters. Blade flapping, flapwise bending, and torsional degrees of freedom were taken into account, with radial variation in aerodynamic loading determined from a previously developed dynamic stall model. Results of analyses were compared with data from flight tests of helicopters. Analyses were carried out while parametrically varying blade vibrational characteristics. It was found that the amplitudes of the higher harmonics of torsional oscillations can be significantly reduced by either reducing the torsional natural frequency or introducing viscous damping in the torsional degree of freedom. A preliminary investigation was conducted to determine the feasibility and practicality of alleviating the stall problem by means of boundary layer control. The results indicate that boundary layer control would be effective in reducing the higher harmonics of torsional oscillations due to stall and that its implementation would not require excessive power or suction rates. Author

N75-32023*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
SUBSONIC AERODYNAMIC CHARACTERISTICS OF INTERACTING LIFTING SURFACES WITH SEPARATED FLOW AROUND SHARP EDGES PREDICTED BY A VORTEX-LATTICE METHOD

John E Lamar and Blair B Gloss Washington Sep 1975 92 p
(NASA-TN-D-7921, L-10001) Avail NTIS HC \$4 75 CSDL 01A

Because the potential flow suction along the leading and side edges of a planform can be used to determine both leading- and side-edge vortex lift, the present investigation was undertaken to apply the vortex-lattice method to computing side-edge suction force for isolated or interacting planforms. Although there is a small effect of bound vortex sweep on the computation of the side-edge suction force, the results obtained for a number of different isolated planforms produced acceptable agreement with results obtained from a method employing continuous induced-velocity distributions. By using the method outlined, better agreement between theory and experiment was noted for a wing in the presence of a canard than was previously obtained. Author

N75-32024*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
POTENTIAL AND VISCOUS FLOW IN VTOL, STOL OR CTOL PROPULSION SYSTEM INLETS

Norbert O Stockman 1975 20 p refs Presented at the Eleventh Propulsion Conf, Anaheim Calif, 29 Sep - 1 Oct 1975, cosponsored by AIAA and SAE
(NASA-TM-X-71799) Avail NTIS HC \$3 25 CSDL 01A

A method was developed for analyzing the flow in subsonic axisymmetric inlets at arbitrary conditions of freestream velocity, incidence angle, and inlet mass flow. An improved version of the method is discussed and comparisons of results obtained with the original and improved methods are given. Comparisons with experiments are also presented for several inlet configurations and for various conditions of the boundary layer from insignificant to separated. Applications of the method are discussed with several examples given for specific cases involving inlets for VTOL lift fans and for STOL engine nacelles. Author

N75-32025*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
A STATIC AIR FLOW VISUALIZATION METHOD TO OBTAIN A TIME HISTORY OF THE LIFT-INDUCED VORTEX AND CIRCULATION

James C Patterson Jr and Frank L Jordan, Jr Sep 1975 11 p ref
(NASA-TM-X-72769) Avail NTIS HC \$3 25 CSDL 01A

A recently proposed method of flow visualization was investigated at the National Aeronautics and Space Administration's Langley Research Center. This method of flow visualization is particularly applicable to the study of lift-induced wing tip

vortices through which it is possible to record the entire life span of the vortex. To accomplish this, a vertical screen of smoke was produced perpendicular to the flight path and allowed to become stationary. A model was then driven through the screen of smoke producing the circular vortex motion made visible as the smoke was induced along the path taken by the flow and was recorded by highspeed motion pictures. Author

N75-32026*# Boeing Commercial Airplane Co., Seattle, Wash
A THREE-DIMENSIONAL SOLUTION OF FLOWS OVER WINGS WITH LEADING-EDGE VORTEX SEPARATION. PART 1. ENGINEERING DOCUMENT
 Guenter W. Brune, James A. Weber, Forrester T. Johnson, Paul Lu, and Paul E. Rubbert. Sep 1975. 98 p. refs.
 (Contracts NAS1-12185, BAS1-13833)
 (NASA-CR-132709, D6-41789-Pt-1) Avail NTIS HC \$4.75 CSCL 01A

A method of predicting forces, moments, and detailed surface pressures on thin, sharp-edged wings with leading-edge vortex separation in incompressible flow is presented. The method employs an inviscid flow model in which the wing and the rolled-up vortex sheets are represented by piecewise, continuous quadratic doublet sheet distributions. The Kutta condition is imposed on all wing edges. Computed results are compared with experimental data and with the predictions of the leading-edge suction analogy for a selected number of wing planforms over a wide range of angle of attack. These comparisons show the method to be very promising, capable of producing not only force predictions, but also accurate predictions of detailed surface pressure distributions, loads, and moments. Author

N75-32027*# Boeing Commercial Airplane Co., Seattle, Wash
A THREE-DIMENSIONAL SOLUTION OF FLOWS OVER WINGS WITH LEADING-EDGE VORTEX SEPARATION. PART 2. PROGRAM DESCRIPTION DOCUMENT
 Ronald G. Coleman, Forrester T. Johnson, and Paul Lu. Sep 1975. 186 p. refs.
 (Contracts NAS1-12185, NAS1-13833)
 (NASA-CR-132710, D6-41789-Pt-2) Avail NTIS HC \$7.00 CSCL 01A

For abstract see N75-32026

N75-32029*# National Aeronautics and Space Administration
 Ames Research Center, Moffett Field, Calif
FIRE SAFETY EVALUATION OF AIRCRAFT LAVATORY AND CARGO COMPARTMENTS
 D. A. Kourides, J. A. Parker, C. J. Hilado (San Francisco Univ., Calif.), R. A. Anderson (Boeing Com. Airplane Co., Seattle Wash.), E. Tustin (Boeing Com. Airplane Co., Seattle Wash.), D. E. Arnold (Boeing Com. Airplane Co., Seattle Wash.), J. G. Gaume (McDonnell-Douglas Corp., Long Beach, Calif.), A. T. Binding (McDonnell-Douglas Corp., Long Beach, Calif.), and J. L. Mikeska (McDonnell-Douglas Corp., Long Beach, Calif.). Aug 1975. 56 p. refs.
 (NASA-TM-X-62471, A-6235) Avail NTIS HC \$4.25 CSCL 01C

Large-scale aircraft lavatory and cargo compartment fire tests are described. Tests were conducted to evaluate the effectiveness of these compartments to contain fire and smoke. Two tests were conducted and are detailed. Test 1 involved a production Boeing 747 lavatory of the latest design installed in an enclosure outside the aircraft, to collect gases and expose animals to these gases. Results indicate that the interior of the lavatory was completely burned, evolving smoke and combustion products in the enclosure. Test 2 involved a simulated Douglas DC-10 cargo compartment retro-fitted with standard fiberglass liner. The fire caused excessive damage to the liner and burned through the ceiling in two areas. Test objectives, methods, materials, and results are presented and discussed. Author

N75-32030*# National Aeronautics and Space Administration
 Langley Research Center, Langley Station, Va
STRAIN-GAGE BRIDGE CALIBRATION AND FLIGHT LOADS MEASUREMENTS ON A LOW-ASPECT-RATIO THIN WING

Ellwood L. Peele and Clinton V. Eckstrom. Washington. Oct 1975. 55 p. refs.
 (NASA-TN-D-7979, L-9896) Avail NTIS HC \$4.25 CSCL 01D

Strain-gage bridges were used to make in-flight measurements of bending moment, shear, and torque loads on a low-aspect-ratio, thin swept wing having a full depth honeycomb sandwich type structure. Standard regression analysis techniques were employed in the calibration of the strain bridges. Comparison of the measured loads with theoretical loads are included. Author

N75-32032*# Goodyear Aerospace Corp., Akron, Ohio
FEASIBILITY STUDY OF MODERN AIRSHIPS, PHASE 1. VOLUME 1. SUMMARY AND MISSION ANALYSIS (TASKS 2 AND 4). Final Technical Report, 9 Dec. 1974 - 9 Apr 1975
 Fred Bloetscher. Aug 1975. 141 p. refs.
 (Contract NAS2-8643)
 (NASA-CR-137692-Vol-1, GER-16146-Vol-1) Avail NTIS HC \$5.75 CSCL 01B

The history, potential mission application, and designs of lighter-than-air (LTA) vehicles are researched and evaluated. Missions are identified to which airship vehicles are potentially suited. Results of the mission analysis are combined with the findings of a parametric analysis to formulate the mission/vehicle combinations recommended for further study. Current transportation systems are surveyed and potential areas of competition are identified as well as potential missions resulting from limitations of these systems. Potential areas of military usage are included. Author

N75-32033*# Goodyear Aerospace Corp., Akron, Ohio
FEASIBILITY STUDY OF MODERN AIRSHIPS, PHASE 1. VOLUME 2. PARAMETRIC ANALYSIS (TASK 3). Final Technical Report, 9 Dec 1974 - 9 Apr 1975
 Jon W. Lancaster. Aug 1975. 144 p. refs.
 (Contract NAS2-8643)
 (NASA-CR-137692-Vol-2, GER-16146-Vol-2) Avail NTIS HC \$5.75 CSCL 01B

Various types of lighter-than-air vehicles from fully buoyant to semibuoyant hybrids were examined. Geometries were optimized for gross lifting capabilities for ellipsoidal airships, modified delta planform lifting bodies, and a short-haul heavy-lift vehicle concept. It is indicated that (1) neutrally buoyant airships employing a conservative update of materials and propulsion technology provide significant improvements in productivity, (2) propulsive lift for VTOL and aerodynamic lift for cruise significantly improve the productivity of low to medium gross weight ellipsoidal airships, and (3) the short-haul heavy-lift vehicle, consisting of a simple combination of an ellipsoidal airship hull and existing helicopter componentry, provides significant potential for low-cost, near-term applications for ultra-heavy lift missions. Author

N75-32034*# Goodyear Aerospace Corp., Akron, Ohio
FEASIBILITY STUDY OF MODERN AIRSHIPS, PHASE 1. VOLUME 3. HISTORICAL OVERVIEW (TASK 1). Final Technical Report, 9 Dec 1974 - 9 Apr 1975
 Gerald L. Faure. Aug 1975. 158 p. refs.
 (Contract NAS2-8643)
 (NASA-CR-137692-Vol-3, GER-16146-Vol-3) Avail NTIS HC \$6.25 CSCL 01B

The history of lighter-than-air vehicles is reviewed in terms of providing a background for the mission analysis and parametric analysis tasks. Data from past airships and airship operations are presented in the following areas: (1) parameterization of design characteristics, (2) markets, missions, costs, and operating procedures, (3) indices of efficiency for comparison, (4) identification of critical design and operational characteristics, and (5) definition of the 1930 state-of-the-art and the 1974 state-of-the-art from a technical and economic standpoint. Author

N75-32035*# Goodyear Aerospace Corp., Akron, Ohio
FEASIBILITY STUDY OF MODERN AIRSHIPS, PHASE 1. VOLUME 4. APPENDICES. Final Technical Report, 9 Dec.

1974 - 9 Apr 1975

Jon W Lancaster Aug 1975 224 p refs
(Contract NAS2-8643)
(NASA-CR-137692-Vol-4, GER-16146-Vol-4) Avail NTIS HC
\$7 25 CSCL 01B
For abstract, see N75-32032

N75-32039# Air Force Systems Command, Wright-Patterson
AFB Ohio Foreign Technology Div
**HYDRODYNAMIC CHARACTERISTICS OF DELTA LOW
ASPECT-RATIO CONFIGURATION WING NEAR SCREEN**
A G Kostin 20 Dec 1974 28 p refs Transl into ENGLISH
from Gidrodinamika Bolshikh Skorostei (USSR), no 5, 1968
p 113-120
(AD-A002891, FTD-MT-24-217-75) Avail NTIS CSCL 01/1

Starting with the one-dimensional integral equation of motion
for the lifting surface of mean aspect ratio, the variational first
approximation is derived for the ordinary differential of the second
order of load distribution. The aerodynamic coefficients of the
delta wing of low aspect ratio were found, and the effects of
wing camber on its characteristics were investigated. It is concluded
that with a decrease in the distance of the wing from the screen,
the center of gravity shifts slightly to the trailing edge of the
wing, and the greater the wing camber, the nearer the center
of gravity to the wing tip. F O S

N75-32042*# Kanner (Leo) Associates, Redwood City, Calif
**OPERATIVE DISTURBANCE REPORTING FOR THE
COMMERCIAL AIRPLANE**

R Axelsson Washington NASA Sep 1975 53 p Transl
into ENGLISH from Swedish report TA-848-R1, 28 Feb 1975
44 p
(Contract NASw-2790)
(NASA-TT-F-16549, TA-848-R1) Avail NTIS HC \$4 25 CSCL
17G

A preliminary investigation concerning disturbance reporting
by taxiplane pilots is discussed. The efficiency of the reporting
format used is examined. Data are provided to serve as a base
from which to determine the frequency and types of disturbances
and incidents occurring. Author

N75-32043# Army Materiel Command, Texarkana, Tex Intern
Training Center

**AIR BAG PROTECTION OF THE GUNNER IN THE US ARMY
COBRA AH-1Q. Final Report**

Thomas M Loushine Apr 1975 62 p refs
(AD-A009421, USAMC-ITC-02-08-75-411) Avail NTIS CSCL
01/3

The new version of the U S Army Cobra attack helicopter,
the AH-1Q, makes use of a new rigid column sighting device.
This rigid column introduces a serious hazard to the gunner
who may come in contact with it during a crash. This report
looks at the possibility of using an inflatable air bag to protect
the gunner from sight inflicted injury. An overall description of
the mechanics and reliability of the air bag as found in present
day automobiles, is included to give the reader a basic understand-
ing of how air bags work. With this understanding, various
considerations are made as to how an air bag system, similar
to an automobile air bag system, could be designed into the
gunner position of the AH-1Q. GRA

N75-32044# National Transportation Safety Board, Washington
D C Bureau of Aviation Safety

**AIRCRAFT ACCIDENT REPORT BRIEF FORMAT U S
CIVIL AVIATION ISSUE NO 4 OF 1974 ACCIDENTS FILE
NUMBERS 1-0001, 1-0032 THRU 1-0035, 1-0037 THRU
1-0038, 3-0001, 3-0188, 3-2701 THRU 3-2978, 3-2980 THRU
3-3038, 3-3040 THRU 3-3600**

14 Mar 1975 511 p refs
(PB-241542/O, NTSB-BA-75-1) Avail NTIS HC \$12 25 CSCL
01B

The publication contains selected aircraft accident reports,
in brief format, occurring in U S civil aviation operations during
calendar year 1974. The 900 general aviation and 7 air carrier

accidents represent a random selection. This publication is issued
irregularly, normally six times each year. The brief format presents
the facts, conditions circumstances, and probable cause(s) for
each accident. Additional statistical information is tabulated by
type of accident phase of operation, kind of flying injury index
aircraft damage conditions of light, pilot certificate injuries, and
causal factors. GRA

N75-32046# Army Electronics Labs, Fort Monmouth, NJ
**AN EXPERIMENTAL EVALUATION OF GATED LOW LIGHT
TV(GL3TV) FOR WIRE OBSTACLE DETECTION. Final
Technical Report**

A Kleider May 1975 49 p refs
(DA Proj 1F2-62202-AH-85)
(AD-A010331 ECOM-4321) Avail NTIS CSCL 17/8

The problem of detecting wire obstacles constitutes a limiting
factor in nighttime nap-of-the-earth helicopter operations.
Several approaches to a solution for the problem are indicated
and a detailed examination of the utilization of a Gated Low
Light Level TV (GL3TV) is presented. The results of a limited
pragmatic test program designed to explore the feasibility of
this technique for wire obstacle detection are given. These results
indicate that the technique is applicable to the problem provided
means can be found to implement automatic acquisition and
pattern recognition within a realistic cost. GRA

N75-32090*# National Aeronautics and Space Administration
Ames Research Center Moffett Field Calif
**HYBRID UPPER SURFACE BLOWN FLAP PROPULSIVE-LIFT
CONCEPT FOR THE QUIET SHORT-HAUL RESEARCH
AIRCRAFT**

John A Cochrane and Robert J Carros Sep 1975 10 p refs
(NASA-TM-X-62477 A-6224) Avail NTIS HC \$3 25 CSCL
01C

The hybrid upper surface blowing concept consists of
wing-mounted turbofan engines with a major portion of the fan
exhaust directed over the wing upper surface to provide high
levels of propulsive lift but with a portion of the fan airflow
directed over selected portions of the airframe to provide boundary
layer control. NASA-sponsored preliminary design studies
identified the hybrid upper surface blowing concept as the best
propulsive lift concept to be applied to the Quiet Short-Haul
Research Aircraft (QSRA) that is planned as a flight facility to
conduct flight research at low noise levels high approach lift
coefficients and steep approaches. Data from NASA in-house
and NASA-sponsored small and large-scale wind tunnel tests of
various configurations using this concept are presented. Author

N75-32091*# National Aeronautics and Space Administration
Langley Research Center Langley Station Va
**MOTION-BASE SIMULATOR STUDY OF CONTROL OF AN
EXTERNALLY BLOWN FLAP STOL TRANSPORT AIRCRAFT
AFTER FAILURE OF AN OUTBOARD ENGINE DURING
LANDING APPROACH**

David B Middleton, George J Hurt Jr, Hugh P Bergeron, James
M Patton, Jr, Perry L Deal and Robert A Champine Washington
Oct 1975 60 p refs
(NASA-TN-D-8026, L-9743) Avail NTIS HC \$4 25 CSCL
01C

A moving-base simulator investigation of the problems of
recovery and landing of a STOL aircraft after failure of an outboard
engine during final approach was made. The approaches were
made at 75 knots along a 6 deg glide slope. The engine was
failed at low altitude and the option to go around was not
allowed. The aircraft was simulated with each of three control
systems, and it had four high-bypass-ratio fan-jet engines
exhausting against large triple-slotted wing flaps to produce
additional lift. A virtual-image out-the-window television display
of a simulated STOL airport was operating during part of the
investigation. Also, a simple heads-up flight director display
superimposed on the airport landing scene was used by the
pilots to make some of the recoveries following an engine failure.
The results of the study indicated that the variation in visual
cues and/or motion cues had little effect on the outcome of a
recovery, but they did have some effect on the pilot's response
and control patterns. Author

N75-32092*# Kanner (Leo) Associates Redwood City, Calif
PERFORMANCE IMPROVEMENT THROUGH CONTROLLER-ASSISTED AIRCRAFT DESIGN

G Loebert Washington NASA Sep 1975 41 p refs Transl into ENGLISH from Deut Ges fuer Luft- und Raumfahrt (Berlin), Oct 1972 27 p
 (Contract NASw-2790)

(NASA-TT-F-16551) Avail NTIS HC \$3.75 CSCL 01C

The possibility is demonstrated of obtaining high potential power increases at only small additional costs by employing artificial instead of natural stabilization. It is shown that if the requirement of static aerodynamic stability is eliminated the drag polars and thus the flight performances can be significantly improved. This improvement occurs mainly in the form of an increase in the specific power reserve at high lift coefficients and in an increase in the attainable maximum lift coefficients. The dynamic flight characteristics of such aircraft can be equal to or better than the characteristics of aerodynamically stable aircraft through an appropriate artificial stabilization. By incorporating suitable redundancies and other provisions, the flight safety of conventional mechanically controlled aircraft can be achieved.

Author

N75-32093*# United Air Lines, Inc. Denver, Colo
ENGINEERING FLIGHT EVALUATION REPORT

John A Morrison 26 Oct 1973 73 p

(Contract NAS2-7208)

(NASA-CR-137755 ROT-75252) Avail NTIS HC \$4.25 CSCL 01C

The primary objective was to determine if the two-segment profile equipment and operational procedures as defined by the B-727 Simulation Evaluation are operationally sound under all flight conditions expected to be encountered in line service. The evaluation was divided into the following areas: (1) to verify that the two-segment system operates as it was designed; (2) to conduct sufficient tests to secure a supplemental type certificate for line operation of the system; (3) to evaluate the normal operation of the equipment and procedures; (4) to evaluate the need for an autothrottle system for two-segment approaches; (5) to investigate abnormal operation of the equipment and procedures including abused approaches and malfunctions of airborne and ground components; (6) to determine the accuracy and ease of flying the two-segment approach; (7) to determine the improvement in ground noise levels; and (8) to develop a guest pilot flight test syllabus.

Author

N75-32094*# National Aeronautics and Space Administration
 Langley Research Center, Langley Station, Va
SUMMARY OF RECENT DESIGN STUDIES OF ADVANCED ACOUSTIC-COMPOSITE NACELLES

Harry T Norton Jr 10 Sep 1975 15 p refs

(Contracts NAS1-13356 NAS1-13233)

(NASA-TM-X-72774) Avail NTIS HC \$3.25 CSCL 01C

The results are summarized of recent NASA-sponsored studies of advanced acoustic-composite nacelles. Conceptual nacelle designs for current wide-bodied transports and for advanced technology transports, intended for operational use in the mid-1980's, were studied by Lockheed-California Company and the Douglas Aircraft Company. These studies were conducted with the objective of achieving significant reductions in community noise and/or fuel consumption with minimum penalties in airplane weights, cost, and operating expense. The results indicate that the use of advanced composite materials offer significant potential weight and cost savings and result in reduced fuel consumption and noise when applied to nacelles. The most promising concept for realizing all of these benefits was a long duct mixed flow acoustic composite nacelle with advanced acoustic liners.

Author

N75-32095*# National Aeronautics and Space Administration
 Langley Research Center, Langley Station, Va
A MATHEMATICAL EXAMINATION OF THE PRESS MODEL FOR ATMOSPHERIC TURBULENCE

Kenneth Sidwell Washington Oct 1975 66 p refs

(NASA-TN-D-8038, L-10150) Avail NTIS HC \$4.25 CSCL 01C

The random process used to model atmospheric turbulence in aircraft response problems is examined. The first, second, and higher order probability density and characteristic functions were developed. The concepts of the Press model lead to an approximate procedure for the analysis of the response of linear dynamic systems to a class of non-Gaussian random processes. The Press model accounts for both the Gaussian and non-Gaussian forms of measured turbulence data. The nonstationary aspects of measured data are explicitly described by the transition properties of the random process. The effects of the distribution of the intensity process upon calculated exceedances are examined. It is concluded that the Press model with a Gaussian intensity distribution gives a conservative prediction of limit load values.

Author

N75-32096# Advisory Group for Aerospace Research and Development, Paris (France)

FLUTTER SUPPRESSION AND STRUCTURAL LOAD ALLEVIATION

Jul 1975 94 p refs. In ENGLISH and partly in FRENCH. Presented at the 40th meeting of the Struct and Mater Panel Brussels, 13-18 Apr 1975.

(AGARD-CP-175) Avail NTIS HC \$4.75

Conference data on advances made in the area of flutter suppression and structural load alleviation are summarized. Particular attention was given to system design behavior, reliability, safety and redundancy, as found by analyses, model and flight tests. The use of active controls to suppress flutter was the dominant subject. The general problem was explored and specific examples and experiences were also presented. Flutter control of the wing/store combination of the empennage and of a straight wing were studied, wind tunnel tests were discussed, automatic pilotage in turbulent air was examined and the mechanization of active controls was reviewed.

N75-32097 McDonnell Aircraft Co. St Louis, Mo
DESIGN CONSIDERATIONS FOR AN ACTIVE SUPPRESSION SYSTEM FOR FIGHTER WING/STORE FLUTTER

C H Perisho, W E Triplett, and W J Mykytow (AFFDL). In AGARD Flutter Suppression and Structural Load Alleviation. Jul 1975 19 p refs.

Results from a previous study on wing/store flutter are extended in a preliminary system design to determine realistic system integration features and to provide a feasibility evaluation of a completely automatic, pilot-out-of-the-loop, adaptive active flutter control system which automatically adjusts a system gain and compensation for different stores on the aircraft. Information obtained included a definition of details involving hydraulic and structural modifications, hardware and software components, flight safety features, expected performance benefits and limitations, and program plans for a wind tunnel verification effort and subsequent flight test demonstrations.

Author

N75-32098 British Aircraft Corp., Filton (England) Commercial Aircraft Div

ACTIVE FLUTTER SUPPRESSION

M R Turner. In AGARD Flutter Suppression and Structural Load Alleviation. Jul 1975 14 p refs.

The use of Root-locus, Nyquist plots and state space theory in the design of active flutter suppression feedback laws is discussed. The concept of an optimum flutter suppression pole placement requirement is introduced. Description and examples are given of Dressler's and Kalman's dynamic observers for state space feedback when only one transducer is used. Examples are given of the effectiveness of feedback laws at off-design conditions for three different types of aircraft. The effect of aileron power control unit rate limit on the aileron control of hard flutter of a high aspect ratio wing in the presence of discrete and random gusts was shown. For a capability of 160 deg/sec, a 20 percent increase of flutter speed can be achieved with very large weight savings. The cutoff frequency usually quoted for the transfer function of power control units is shown to

underestimate its flutter control capabilities. The possible need for feedback laws based upon flight test measurements is discussed. Author

N75-32099 Messerschmitt-Boelkow-Blohm G m b H, Munich (West Germany)

ACTIVE CONTROL OF EMPENNAGE FLUTTER

O Sensburg, H Hoenlinger, and M Kuehn /In AGARD Flutter Suppression and Structural Load Alleviation Jul 1975 11 p refs

After a successful application of the active flutter control technology on a wingstore flutter problem, an extension of this technology to an empennage flutter problem was considered. The task was to develop, build and test a control system which actively suppresses a total airplane model flutter problem by counteracting with a hydraulically driven rudder. The flutter phenomenon described is characterized by large contributions of fuselage torsional movement therefore producing high inertial forces in comparison with unsteady aerodynamic forces. These properties lead to a mild onset of flutter. For the same reason no rapid phase changes of the flutter mode near the flutter point are occurring. Author

N75-32100 Boeing Co, Wichita, Kans
WIND TUNNEL INVESTIGATION OF CONTROL CONFIGURED VEHICLE SYSTEMS

G O Thompson and F D Sevart /In AGARD Flutter Suppression and Structural Load Alleviation Jul 1975 8 p refs

Research studies was conducted to demonstrate active flutter mode control and forward body ride control systems on a one-thirtieth scale B-52E aeroelastic model. The NASA model, originally designed and constructed for low speed gust response testing, was modified to represent the airplane used in the B-52 control configured vehicle (CCV) flight test program. The CCV program flutter mode control and vertical ride control systems were scaled to model frequency and tested in the transonic dynamics tunnel at conditions equivalent to airplane flight test conditions. Wind tunnel test results were compared with model analytical and airplane flight test results. The good correlation demonstrates wind tunnel test models can be employed to verify CCV system analysis and synthesis results, thus reducing risks involved in a new airplane development. Author

N75-32101 Office National d'Etudes et de Recherches Aeronautiques, Paris (France)
CLOSED FORM EXPRESSION OF THE OPTIMAL CONTROL OF A RIGID AIRPLANE TO TURBULENCE

Gabriel Coupry /In AGARD Flutter Suppression and Structural Load Alleviation Jul 1975 8 p refs. In FRENCH ENGLISH summary.

An explanation is given as to how Wiener's theory makes it possible to derive in closed form, the transfer function of the filter used for control. It shows that this transfer function can be expressed in autoadaptive form, the poles being proportional to the velocity of the aircraft. The influence of parameters like mass, scale of turbulence, is discussed. Finally a comparison is given between results of flight test and prediction. Author

N75-32102 Office National d'Etudes et de Recherches Aeronautiques, Paris (France)
WIND TUNNEL TEST OF A FLUTTER SUPPRESSOR ON A STRAIGHT WING

Roger Destuynder /In AGARD Flutter Suppression and Structural Load Alleviation Jul 1975 3 p. In FRENCH, ENGLISH summary.

A study was made of flutter due to a load hung under the wing of an aircraft. Special attention was given to aerodynamic and natural structural modes. Using an aerodynamically uncoupled control surface made it possible to simplify the transfer function of the servo-system. The control obtained this way is not optimal but it does not require a precise knowledge of the aerodynamic forces and the wing dynamic characteristics, and provides an increased damping ratio in the whole velocity range. Author

N75-32103 Sperry Rand Corp, Phoenix, Ariz

MECHANIZATION OF ACTIVE CONTROL SYSTEMS

James B Flannigan and Thomas R Elliott /In AGARD Flutter Suppression and Structural Load Alleviation Jul 1975 14 p refs

Characteristics and limitations of current active control systems, in their ability to satisfy the requirements of more precise control of gain/phase relationships and flight safety implications, are discussed. Solutions to the potential shortcomings of these systems were also covered. Author

N75-32104 Hydraulic Research and Mfg Co., Valencia, Calif
HYDRAULIC CONTROLS FOR ACTIVE FLUTTER SUPPRESSION AND LOAD ALLEVIATION

Don A Wiggins /In AGARD Flutter Suppression and Structural Load Alleviation Jul 1975 12 p refs

A description is given of how system requirements influence the design and redundancy mechanizations of the hydraulic actuation portion of the flight control system. Some of the redundant hydraulic actuation concepts being used on advanced vehicles such as the NASA F-8 digital fly-by-wire aircraft and the space shuttle are discussed by examples. A summary is given of the present technology available in the field of redundant electrohydraulic actuation systems. Author

N75-32105# Army Aviation Engineering Flight Activity, Edwards AFB, Calif

ARMY PRELIMINARY EVALUATION 1 MODEL 200 CEFLY LANCER Final Report, 20 Feb - 6 Mar 1974

George M Yamakawa, Tom P Benson, Larry K Brewer, and Michael A Hawley Jun 1974 142 p refs
(AD-A009713, USAAEFA-74-21-1) Avail NTIS CSCL 01/3

The United States Army Aviation Engineering Flight Activity conducted an Army Preliminary Evaluation of the Model 200 CEFLY LANCER aircraft manufactured by Beech Aircraft Corporation from 20 February to 6 March 1974 at the Beech facility in Wichita, Kansas. During the test program, 248 productive hours were flown. Performance, stability and control characteristics, and miscellaneous engineering tests were conducted. GRA

N75-32106# Army Aviation Engineering Flight Activity, Edwards AFB, Calif

ARMY PRELIMINARY EVALUATION 2 MODEL 200 CEFLY LANCER Final Report, 27 Apr - 15 May 1974

George M Yamakawa, Tom P Benson, and Larry K Brewer Aug 1974 78 p refs
(AD-A009714, USAAEFA-74-21-2) Avail NTIS CSCL 01/3

The United States Army Aviation Engineering Flight Activity conducted Army Preliminary Evaluation (APE) 2 of the Model 200 CEFLY LANCER aircraft, manufactured by Beech Aircraft Corporation from 27 April to 15 May 1974 at the Beech facility in Wichita, Kansas. During the test program, 73 productive hours were flown. Performance, stability and control characteristics, and miscellaneous engineering tests were conducted. GRA

N75-32107# McDonnell-Douglas Astronautics Co, St Louis Mo, Life Sciences Div

IMPACT OF DESIGN TRADE STUDIES ON SYSTEM HUMAN RESOURCES Final Report, May 1973 - Jul 1974

Gary V Whalen and William B Askren Dec 1974 68 p refs
(Contract F33615-73-C-4150)
(AD-A009639, AFHRL-TR-74-89) Avail NTIS CSCL 05/9

The study was undertaken to accomplish two objectives. The first objective was to identify and classify the characteristics of conceptual design trade studies that have high potential impact on human resource requirements of Air Force weapon systems. The approach used was a case history review and analysis of 129 F-15 aircraft design trade studies. The analysis indicated that the avionics system demonstrated the greatest potential impact on human resources. The types of human resources data (HRD) most influenced by alternative design options were maintenance task times and personnel costs. The second study objective was to determine the accuracy of using subjective estimates as a technique for deriving the HRD impact of trade

study options Using only engineering information for six avionics subsystems, from the conceptual design phase, Air Force maintenance technicians made subjective estimates of the impact of the designs on selected HRD items It was found that technicians can make highly accurate estimates of the amount of time, the Air Force occupational specialty, the level of technical skill and the number of personnel needed to perform field maintenance tasks GRA

N75-32108# Army Aviation Engineering Flight Activity, Edwards AFB, Calif

ARTIFICIAL ICING TESTS AH-1G HELICOPTER Final Report, 22 Oct 1973 - 2 Apr 1974

Carl F Mittag, Raymond B Smith, Marvin L Hanks, and James S Reid Nov 1974 94 p refs
(AD-A009712, USAAEFA-73-04-2) Avail NTIS CSCL 01/3

The United States Army Aviation Engineering Flight Activity conducted a limited in-flight artificial icing evaluation of the AH-1G helicopter from 22 October through 6 November 1973 at Fort Wainwright, Alaska, and from 22 March through 2 April 1974 in the vicinity of Moses Lake, Washington During the test program 85 hours of productive flight time were flown, of which 40 hours were in the artificial icing environment Three deficiencies were noted which adversely affect the safe operation of the AH-1G helicopter in an icing environment GRA

N75-32109# Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Technology Div

APPLICATION OF A VARIATION-DIFFERENCE IN CALCULATIONS OF SHORT WING ASPECT RATIOS

T G Zuraev 27 Jan 1975 23 p Transl into ENGLISH from Tsentralnyi Aerogidrodinamicheskii Inst Uchen Zap (USSR), v 2, no 4, 1971 p 90-95

(AD-A007102, FTD-MT-24-0467-75) Avail NTIS CSCL 01/3

The application and use of a combined method for calculating short wing aspect ratios are reported A structurally anisotropic plate is investigated as the analog of the aspect ratios The possibilities and accuracy of the method are noted GRA

N75-32111# Center for Naval Analyses, Arlington, Va Operations Evaluation Group

AN AIR COMBAT MANEUVER CONVERSION MODEL

Richard A Oberle Nov 1974 26 p refs

(Contract N00014-68-A-0091)

(AD-A010539 CRC-274) Avail NTIS CSCL 15/7

A model that characterizes an air-to-air engagement as a semi-Markov process is described Included is a discussion of the model's assumptions and effectiveness measures with instructions for applying the model to experiments characterizing offensive and defensive maneuvering capability in air combat GRA

N75-32112# Systems Control, Inc, Palo Alto, Calif

INSTRUMENTATION REQUIREMENTS FOR AIRCRAFT PARAMETER IDENTIFICATION WITH APPLICATION TO THE HELICOPTER

J A Sorensen, R L Mohr, and T B Cline Jun 1975 163 p refs

(Contract NAS1-12876)

(NASA-CR-132675) Avail NTIS HC \$6 25 CSCL 01D

The extent to which instrumentation errors cause degradation in the knowledge of stability and control derivatives identified for flight tests was studied along with the resultant degradation of the flight system performance base on these derivatives The error in measurement and data processing systems used for parameter identification, error analysis techniques, and the effects of instrumentation errors on the accuracy of parameter estimates are discussed The analysis programs were used to study instrumentation error effects on the accuracy of the identified stability and control derivatives of the CH-46 helicopter F O S

N75-32113# Systems Control, Inc Palo Alto, Calif

FLIGHT INSTRUMENTATION SPECIFICATION FOR PARAMETER IDENTIFICATION PROGRAM USER'S GUIDE

R L Mohr Jun 1975 134 p refs

(Contract NAS1-10791)

(NASA-CR-132876) Avail NTIS HC \$5 75 CSCL 01D

A set of four digital computer programs is presented which can be used to investigate the effects of instrumentation errors on the accuracy of aircraft and helicopter stability-and-control derivatives identified from flight test data The programs assume that the differential equations of motion are linear and consist of small perturbations about a quasi-steady flight condition It is also assumed that a Newton-Raphson optimization technique is used for identifying the estimates of the parameters Flow charts and printouts are included Author

N75-32117# Santa Clara Univ, Calif

PRELIMINARY CORE-ENGINE NOISE ABATEMENT EXPERIMENTAL RESULTS OF A FLUID INJECTION NOZZLE ON A JT-15D TURBOFAN ENGINE

Dah Yu Cheng and Peter Wang 24 Sep 1975 41 p refs

(Grant NGR-05-017-033)

(NASA-CR-137744) Avail NTIS HC \$3 75 CSCL 21E

Jet noise, as induced by shear stress, in an jet exhaust is investigated Experiments were performed on a JT-15D fan jet to verify the inward momentum stress reduction concept The experiments involved making fan air flow convergently around the high velocity core jet with a small angle Ring airfoils were used as flow separators for the minimization of the thrust loss Jet exhaust noise reduction of 11 db at 30 deg from the jet axis was recorded and 8 db integrated overall noise reduction over a hemisphere was measured with only 4.6% thrust loss, or 152 db/percent thrust loss Author

N75-32119# National Aeronautics and Space Administration Flight Research Center, Edwards, Calif

REVIEW OF AIRCRAFT NOISE PROPAGATION

Terrill W Putnam Sep 1975 61 p refs

(NASA-TM-X-56033) Avail NTIS HC \$4 25 CSCL 20A

The current state of knowledge about the propagation of aircraft noise was reviewed The literature on the subject is surveyed and methods for predicting the most important and best understood propagation effects are presented Available empirical data are examined and the data's general validity is assessed The methods used to determine the loss of acoustic energy due to uniform spherical spreading absorption in a homogeneous atmosphere, and absorption due to ground cover are presented A procedure for determining ground induced absorption as a function of elevation angle between source and receiver is recommended Other factors that affect propagation, such as refraction and scattering due to turbulence, which were found to be less important for predicting the propagation of aircraft noise, are also evaluated Author

N75-32120# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

EFFECT ON FUEL PROPERTIES OF PERFORMANCE OF A SINGLE AIRCRAFT TURBOJET COMBUSTOR

Helmut F Butze and Robert C Ehlers 1975 16 p refs Presented at Fall Meeting of the Western States Section of the Combust Inst Palo Alto Calif 20-21 Oct 1975

(NASA-TM-X-71789, E-8454) Avail NTIS HC \$3 25 CSCL 21E

The performance of a single-can JT8D combustor was investigated with a number of fuels exhibiting wide variations in chemical composition and volatility Performance parameters investigated were combustion efficiency, emissions of CO, unburned hydrocarbons and NOx, as well as liner temperatures and smoke At the simulated idle condition no significant differences in performance were observed At cruise liner temperatures and smoke increased sharply with decreasing hydrogen content of the fuel No significant differences were observed in the performance of an oil-shale derived JP-5 and a petroleum-based Jet A fuel except for emissions of NOx which were higher with the oil-shale JP-5 The difference is attributed to the higher concentration of fuel-bound nitrogen in the oil-shale JP-5 Author

N75-32122# General Electric Co., Cincinnati, Ohio Aircraft Engine Group

CORE ENGINE NOISE CONTROL PROGRAM VOLUME 1 IDENTIFICATION OF COMPONENT NOISE SOURCES Final Report, Jul 1972 - Apr 1974

K R Bilwakesh, V G Harris, S B Kazin, D Latham, R K Matta, H Morozumi, R E Motsinger, and H D Sowers Aug 1974 109 p refs

(Contract DOT-FA72WA-3023)

(AD-A013128/4, FAA-RD-74-125-Vol-1) Avail NTIS HC \$5 25 CSCL 21/5

Various noise sources constituting the core engine noise for turbofan engines were identified and rank ordered. An investigation was made to ascertain the generating mechanisms, controlling variables means of identification, and the effect on engine design if reduction were required for each of eight core engine noise sources. The relative significance of the various noise sources was evaluated by predicting the noise contribution of the individual components. The predictions were made for each of the three hypothetical cycles for bypass ratios of 4, 7, and 14, respectively, which were formulated to encompass a range of commercial aircraft powerplants. It was determined that combustor noise, jet noise, turbine and turbine jet interaction noise and obstruction noise would constitute the major noise sources, while casing radiation and compressor noise would act as secondary sources.

Author

N75-32123# General Electric Co., Cincinnati, Ohio Aircraft Engine Group

CORE ENGINE NOISE CONTROL PROGRAM. VOLUME 2. IDENTIFICATION OF NOISE GENERATION AND SUPPRESSION MECHANISMS Final Report, Jul 1972 - Apr 1974

K R Bilwakesh, W S Clapper, J J Emmerling, S B Kazin, P R Knott, D Latham, R K Matta and H Morozumi Aug 1974 504 p refs

(Contract DOT-FA72WA-3023)

(AD-A013129/2, FAA-RD-74-125-Vol-2) Avail NTIS HC \$12 25 CSCL 21/5

The mechanisms of noise generation and suppression for the various core engine noise sources in turbofans were defined through a balanced analytical and experimental program. Model, component, and engine tests were used to substantiate the results of the analysis and to determine the basic noise generating parameters. The results were cast in a general form so as to be applicable to a wide variety of cycles, including future technology turbofan engines. Several suppression concepts were identified through analysis and through logical extension of experience with earlier programs on high velocity jet noise and fan/compressor noise research. The suppression concepts were validated through model and component tests and through evaluation of available engine data.

Author

N75-32124# General Electric Co., Cincinnati, Ohio Aircraft Engine Group

CORE ENGINE NOISE CONTROL PROGRAM VOLUME 3 PREDICTION METHODS Final Report, Jul 1972 - Apr 1974

K R Bilwakesh, J J Emmerling, S B Kazin, D Latham, R K Matta, and H Morozumi Aug 1974 165 p refs

(Contract DOT-FA72WA-3023)

(AD-A013131/8, FAA-RD-74-125-Vol-3) Avail NTIS HC \$7 00 CSCL 21/5

Prediction methods for core engine noise were reviewed and either updated or new noise evaluation techniques formulated for low velocity coannular jets, combustors ("core" noise), low pressure turbines, interaction between turbine tones and fan/core jet streams, obstructions in the flow passages, and casing radiation. The development was based, to a large extent, on the analytical investigation and the model, component, and engine tests. The results were cast in a general form, so as to be applicable to a wide variety of cycles, including present and future turbofan engines. The prediction methods were validated with measured acoustic data wherever possible.

Author

N75-32125# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

EFFECT OF A 180 DEG-EXTENT INLET PRESSURE DISTORTION ON THE INTERNAL FLOW CONDITIONS OF A TF30-P-3

Claude E DeBogdan, John H Dicus, David G Evans, and Ronald H Soeder Washington Sep 1975 63 p refs
(NASA-TM-X-3267, E-8206) Avail NTIS HC \$4 25 CSCL 21E

The measured effects of inlet pressure distortion on the internal flow temperatures and pressures of a TF30-P-3 afterburning turbofan engine are reported. Extensive inner-stage instrumentation combined with stepwise rotation of pressure distortion provided a high degree of circumferential resolution in the data. The steady-state spatial variation in pressures, temperature, and calculated flow velocity and the amplitude and extent of the distorted sectors are given. Data are presented for runs of 77 and 90 percent of low-speed-rotor design speed at pressure distortion levels two-thirds of that required to stall the engine. These data are compared with data taken at clean-inlet conditions. Results indicate that the inlet pressure distortion was quickly attenuated within the compressor, except at the hub of the low-pressure compressor. The distorted sectors also swirled and varied in extent as they passed through the engine. Average velocities within the compressor were about equal to the clean-inlet values.

Author

N75-32126# General Electric Co., Evendale, Ohio NASA/NAVY LIFE/CRUISE FAN PRELIMINARY DESIGN REPORT

Jul 1975 180 p refs

(Contract NAS3-19411)

(NASA-CR-134837, R75AEG414) Avail NTIS HC \$7 00 CSCL 21E

Preliminary design studies were performed to define a turboprop lift/cruise fan propulsion system for a Navy multimission aircraft. The fan is driven by the exhausts of the YJ97-GE-100 turbojet or a 20 percent Growth J97 configuration as defined during the studies. The LCF459 fan configuration defined has a tip diameter of 150 meters (590 inches) and develops a design point thrust of 75,130 N (16,890 lbs) at a fan pressure ratio of 1.319. The fan has an estimated weight of 386 kg (850 lbs). Trade studies performed to define the selected configuration are described.

Author

N75-32127# National Aerospace Lab., Tokyo (Japan) DETERMINATION OF LONGITUDINAL STABILITY AND CONTROL DERIVATIVES OF THE QUEEN AIR

Mikihiko Mori, Mitsuyoshi Mayanagi, Takayuki Nagoshi, Yoshio Goto, and Yushi Osterui Feb 1975 31 p refs In JAPANESE, ENGLISH summary

(NAL-TR-406) Avail NTIS HC \$3 75

The longitudinal stability and control derivatives of the Beechcraft Queen Air-Model 65 were determined from the flight data for landing and cruising flight configurations. The result will be used for designing an automatic landing system for the airplane. To analyze the flight data, the least square method of conventional derivative type was adopted. The raw estimates of derivatives with considerable variations depending upon the sampling intervals, were shown. The final value of each derivative was determined by a simulated computation, and was compared with the wind tunnel test data. The accuracy of the derivatives is estimated to be of about 50 percent error for stability derivatives and less than 30 percent for control derivatives.

Author

N75-32128# Massachusetts Inst of Tech., Cambridge Electronics Systems Lab

INVESTIGATION OF THE MULTIPLE MODEL ADAPTIVE CONTROL (MMAC) METHOD FOR FLIGHT CONTROL SYSTEMS Status Report, No 3, 1 May - 30 Sep 1975

1 Oct 1975 28 p refs

(Grant NsG-1018, MIT Proj OSP-81706)

(NASA-CR-119133, ESL-SR-626) Avail NTIS HC \$3 75 CSCL 01C

The application was investigated of control theoretic ideas to the design of flight control systems for the F-8 aircraft. The design of an adaptive control system based upon the so-called multiple model adaptive control (MMAC) method is considered. Progress is reported.

Author

N75-32129# ARO, Inc., Arnold Air Force Station, Tenn
A TECHNIQUE FOR MAPPING AIRCRAFT STABILITY BOUNDARIES Final Report, Jul 1973 - Dec 1974

James L Taylor AEDC May 1975 56 p refs Sponsored by AF

(AD-A010492, ARO-PWT-TR-75-14, AEDC-TR-75-46) Avail NTIS CSCL 20/4

This study presents a method for determining the effect that variations in design parameters may have on the transient response characteristics of a system of differential equations. The effects of single design parameter variations are described using a modified root locus technique. Simultaneous variations of two or three parameters are described using stability region maps. GRA

N75-32130# Systems Control Inc., Palo Alto, Calif
ANALYSIS OF CONTROLLER/SYSTEM DYNAMICS FOR A REMOTELY PILOTED VEHICLE STRIKE MISSION Final Report

Anil Phatak, Narendra Gupta and Ilana Seagall May 1975 54 p refs

(Contract F33615-73-C-4021, AF Proj 7222)

(AD-A009958, AMRL-TR-74-80) Avail NTIS CSCL 01/3

The development of an analytical model for the remote human controller/vehicle dynamics during the critical phases of a remotely piloted vehicle (RPV) strike mission is a prerequisite for the quantitative understanding and evaluation of the overall mission effectiveness. The purpose of this report is to develop such a modeling approach and demonstrate its usefulness as an effective tool in the design of a baseline RPV strike mission. Analysis of the controller/vehicle dynamics is used to isolate the principal causes of degradations in the overall weapon system effectiveness. Insight gained from these analyses should prove extremely valuable in selecting a baseline configuration including specific recommendations for the choice of displays, the vehicle augmentation and the overall RPV strike mission flight profile. GRA

N75-32131# Naval Postgraduate School, Monterey, Calif
A MODEL BASED TECHNIQUE FOR FLIGHT DIRECTOR DESIGN HELICOPTER HOVERING FLIGHT M S Thesis

Anthony John Palazzo, Jr Mar 1975 51 p refs

(AD-A009976) Avail NTIS CSCL 01/2

A computer-aided optimal pilot modeling procedure was utilized to develop flight director laws for implementation in the longitudinal mode of a head-down cockpit display for a vertical take-off and landing aircraft. These flight director laws were intended to enhance the instrument hover and landing capabilities of the Bell UH-1H helicopter equipped with a multi-function stroke-written cathode ray tube display. GRA

N75-32186# Naval Air Development Center, Warminster, Pa
EFFECTS OF GRAPHITE-EPOXY COMPOSITE MATERIALS ON THE CORROSION BEHAVIOR OF AIRCRAFT ALLOYS

P Fischer and J DeLuccia 3 Apr 1975 38 p refs

(AD-A010127, NADC-75031-30) Avail NTIS CSCL 11/6

The electrochemical approach was used to show the nature of the galvanic corrosion when graphite-epoxy composite materials are coupled to aluminum and titanium alloys. An open circuit potential difference of one volt was obtained in 3.5% NaCl solution between the composite and 7075-T6, 7075-T651 and 5052-H38 alloys. This potential difference provides a driving force for corrosion and is cause for concern. The Ti-6-4 showed a difference of about 0.3 volt for the unpolished as received material. Corrosion current data (zero impedance technique) indicate that aluminum alloys and cadmium plate are much more reactive than Ti-6-4 when coupled to graphite-epoxy. This technique provides a means of ranking the severity of this corrosion problem for various aircraft alloys. Flatwise tensile data indicate significant strength losses when graphite-epoxy composite sandwich specimens are exposed to ASTM 5% salt spray and synthetic sea water - SO2 spray environments. GRA

N75-32378 Pennsylvania State Univ University Park
ON THE INVESTIGATION OF CASCADE AND TURBOMA

CHINERY ROTOR WAKE CHARACTERISTICS Ph D Thesis

Rishi Raj 1974 202 p

Avail Univ Microfilms Order No 75-19919

The constitutive equations for the rotor wake were developed using generalized tensors and a noninertial frame of reference. Analytical and experimental investigation was carried out in two phases. The first phase involved the study of a cascade wake in the absence of rotation and three dimensionality. In the second phase the wake of a rotor was studied. Simplified two- and three-dimensional models were developed for the prediction of the mean velocity profile of the cascade and the rotor wake respectively, using the principle of self-similarity. The effect was studied of various major parameters of the rotor and the flow geometry on the development of a rotor wake. Laws governing the decay of the wake velocity defect in a cascade and rotor wake as a function of downstream distance from the trailing edge, pressure gradient and other parameters are derived. Experimental investigations on the study of cascade and rotor wake were carried out in a cascade tunnel and axial flow fan facilities. Two and three sensor hot wire probes were used to measure the mean velocity and turbulence quantities of a cascade and a rotor wake. Dissert Abstr

N75-32411# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div

UNSTEADY PROBLEM OF THE SUDDEN MOTION OF WEDGE AND CONE AT SUB- AND SUPERSONIC SPEEDS

R Ya Tugazakov 4 Feb 1975 28 p refs Transl into ENGLISH from Tsentr Aerogidrodinamicheskii Inst Uch Zap (USSR) v 4 no 1, 1973 p 1-9

(AD-A007236, FTD-MT-24-0493-75) Avail NTIS CSCL 20/4

The aerodynamic characteristics of wings and conical bodies at sub- and supersonic speeds are determined. Factors considered include sudden motions, constant velocity flow and wing pressure distribution. J M S

N75-32503*# General Dynamics/Fort Worth Tex
DESIGN AND FABRICATION OF COMPOSITE WING PANELS CONTAINING A PRODUCTION SPLICE

D L Reed Washington NASA Aug 1975 79 p refs

(Contract NAS1-11974)

(NASA-CR-2549) Avail NTIS HC \$4.75 CSCL 20K

Bolted specimens representative of both upper and lower wing surface splices of a transport aircraft were designed and manufactured for static and random load tension and compression fatigue testing including ground-air-ground load reversals. The specimens were fabricated with graphite-epoxy composite material. Multiple tests were conducted at various load levels and the results were used as input to a statistical wearout model. The statically designed specimens performed very well under highly magnified fatigue loadings. Two large panels, one tension and compression were fabricated for testing by NASA-LRC. Author

N75-32507*# Battelle Columbus Labs., Ohio
CONSOLIDATION OF FATIGUE AND FATIGUE-CRACK-PROPAGATION DATA FOR DESIGN USE Final Report

Richard C Rice, Kent B Davies, Carl E Jaske, and Charles E Feddersen Washington NASA Oct 1975 76 p refs

(Contract NAS1-13358)

(NASA-CR-2586) Avail NTIS HC \$4.75 CSCL 11F

Analytical methods developed for consolidation of fatigue and fatigue-crack-propagation data for use in design of metallic aerospace structural components are evaluated. A comprehensive file of data on 2024 and 7075 aluminums, Ti-6Al-4V alloy and 300M steel was established by obtaining information from both published literature and reports furnished by aerospace companies. Analyses are restricted to information obtained from constant-amplitude load or strain cycling of specimens in air at room temperature. Both fatigue and fatigue-crack-propagation data are analyzed on a statistical basis using a least-squares regression approach. For fatigue, an equivalent strain parameter is used to

account for mean stress or stress ratio effects and is treated as the independent variable cyclic fatigue life is considered to be the dependent variable. An effective stress-intensity factor is used to account for the effect of load ratio on fatigue-crack-propagation and treated as the independent variable. In this latter case crack-growth rate is considered to be the dependent variable. A two term power function is used to relate equivalent strain to fatigue life and an arc-hyperbolic-tangent function is used to relate effective stress intensity to crack-growth rate. Author

N75-32871*# Wyle Labs Inc Hampton Va
DETERMINATION OF ROTOR HARMONIC BLADE LOADS FROM ACOUSTIC MEASUREMENTS Final Report
 Peter K Kasper Washington NASA Oct 1975 66 p refs (Contract NAS1-12390)
 (NASA-CR-2580) Avail NTIS HC \$4 25 CSCL 20A

The magnitude of discrete frequency sound radiated by a rotating blade is strongly influenced by the presence of a nonuniform distribution of aerodynamic forces over the rotor disk. An analytical development and experimental results are provided for a technique by which harmonic blade loads are derived from acoustic measurements. The technique relates on a one-to-one basis, the discrete frequency sound harmonic amplitudes measured at a point on the axis of rotation to the blade-load harmonic amplitudes. This technique was applied to acoustic data from two helicopter types and from a series of test results using the NASA-Langley Research Center rotor test facility. The inferred blade-load harmonics for the cases considered tended to follow an inverse power law relationship with harmonic blade-load number. Empirical curve fits to the data showed the harmonic fall-off rate to be in the range of 6 to 9 db per octave of harmonic order. These empirical relationships were subsequently used as input data in a compatible far field rotational noise prediction model. A comparison between predicted and measured off-axis sound harmonic levels is provided for the experimental cases considered. Author

N75-32872*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
AN OBSERVATION ON TONE CUT-OFF IN STATIC TEST DATA FROM JET ENGINE FANS
 Marcus F Heidmann Washington Sep 1975 7 p refs (NASA-TM-X-3296 E-8409) Avail NTIS HC \$3 25 CSCL 20A

The far-field acoustic data for eight full-scale fans tested at a NASA-Lewis outdoor facility were analyzed for the effect of a cut-off design feature where the number of rotor and stator blades are proportioned so that the blade-passage tone will not propagate. Inlet flow distortions prevalent during static testing, interact with the rotor to generate tones that generally mask this cut-off phenomenon. Distortion tone properties previously evaluated are used to analyze the tones propagating from the aft fan duct. The analyzed data clearly differentiated the fans that are and are not cut-off. Author

N75-32998 West Virginia Univ, Morgantown
ANALYSIS OF CIRCULATION CONTROLLED AIRFOILS Ph D. Thesis
 Edward Harold Gibbs 1975 197 p
 Avail Univ Microfilms Order No 75-21943

A self-contained analysis for arbitrary circulation controlled airfoils in incompressible flow was developed. The analysis predicts the blowing slot conditions required to produce a specified lift coefficient on a given airfoil with given free stream conditions. An iterative procedure is used to find the blowing slot conditions that allow the Thwaites condition of constant pressure in the separated region to be satisfied. With the input given a potential flow analysis is performed using the Theodorsen method. Boundary layer analyses for the lower and upper surfaces then yield the separation pressure on the lower surface and the boundary layer properties at the slot on the upper surface. The flow is initially laminar and usually becomes turbulent. The Cebeci-Smith finite difference method is used and an eddy viscosity model is used for turbulent flow. Blowing slot values are assumed

and a turbulent wall jet analysis is performed to determine the wall pressure at separation on the upper surface. Dissert Abstr

N75-32999 West Virginia Univ, Morgantown
HELICOPTER LIFTING SURFACE THEORY WITH FORCE FREE WAKE Ph D Thesis
 Hsi Frank Chou 1975 147 p
 Avail Univ Microfilms Order No 75-21939

Steady potential flow nonlinear lifting surface theory is applied to an arbitrary helicopter rotor system in constant rotational and constant axial translational motion including hover. An unknown velocity doublet distribution is imposed on both the blade and wake surfaces, satisfying the normal boundary conditions on the true wetted surface and the Kutta condition at the trailing edge. The governing equation, then becomes a Fredholm integral equation of the first kind. A numerical scheme is developed to solve the doublet strength distribution by approximating the surface with a finite number of uniformly loaded elements and satisfying the boundary conditions at their centroids. The integral equation is thereby transformed into a system of linear algebraic equations. The solution provides the velocity magnitude and direction, and the pressures on the blade surface. Dissert Abstr

N75-33000*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
A MOMENTUM ANALYSIS OF HELICOPTERS AND AUTOGYROS IN INCLINED DESCENT, WITH COMMENTS ON OPERATIONAL RESTRICTIONS
 Harry H Heyson Washington Oct 1975 82 p refs (NASA-TN-D-7917, L-10045) Avail NTIS HC \$4 75 CSCL 01A

A momentum theory was developed for rotors in descending flight. Comparison with available experimental data indicates that the theory, when properly interpreted yields the optimum performance of the rotor. Power settling can be explained on the basis of the theory. The reasons and the need for operational restrictions on descending flight are discussed. The maximum autorotative performance of a rotor is determined the theory shows good agreement with flight measurements in autorotation. Similar equations were developed for a wing, it was shown that the ideal performance of an autorotating rotor is identical to that of a wing of equal aspect ratio. A limiting maximum wing lift coefficient which is confirmed by existing experimental data was obtained. Author

N75-33001*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
EFFECT OF WALL SUCTION ON PERFORMANCE OF A SHORT ANNULAR DIFFUSER AT INLET MACH NUMBERS UP TO 0.5
 Albert J Juhasz Washington Oct 1975 24 p refs (NASA-TM-X-3302, E-8393) Avail NTIS HC \$3 25 CSCL 20D

A short annular diffuser equipped with wall bleed (suction) capability was evaluated at inlet Mach numbers of 0.186 to 0.5. The diffuser had an area ratio of 4.0 and a length-to-inlet height ratio of 1.6. Test results show that the exit velocity profiles, typical of annular jet flow without suction, could be considerably flattened by application of wall suction. This improved performance was also reflected in diffuser effectiveness (static-pressure recovery) and total-pressure loss results. At the inlet Mach number of 0.5 diffuser static-pressure recovery is equal to or better than at lower inlet Mach numbers for comparable suction rates. Author

N75-33002*# Kanner (Leo) Associates, Redwood City, Calif
THEORY OF INDUCTION OF A HEAVILY LOADED PROPELLER
 E D Safronov Washington NASA Oct 1975 16 p refs Transl into ENGLISH from Uch Zap (USSR), v 4 no 4 1973 p 99-107 (Contract NASw-2790)
 (NASA-TT-F-16612) Avail NTIS HC \$3 25 CSCL 01A

A heavily loaded propeller theory is developed on the basis of exact solutions obtained within the framework of the theory

of a weakly loaded propeller. Expressions are derived for the components of the velocity induced at an arbitrary point in space by a heavily loaded propeller. The expressions are useful in the solution of various propeller interference problems. Author

N75-33003* Boeing Vertol Co., Philadelphia, Pa
FEASIBILITY STUDY OF MODERN AIRSHIPS, PHASE 1, VOLUME 1 Final Report
 B. Joner, May 1975, 457 p, refs
 (Contract NAS2-8693)
 (NASA-CR-137691-Vol-1, D210-10953-1-Vol-1) Avail NTIS HC \$11.50 CSCL 01B

The history of the airship is examined from a technical and operational/mission point of view. The impact on a modern airship design by present technology is defined in some selected, representative areas through a comparison between 1930 and 1975 state-of-the-art. A survey of missions with a potential for the airship was made and some viable applications are established. Several concepts of modern airships were taken through a parametric design analysis in the missions previously established, evolving in a new configuration of a hybrid airship - the Helipsoid -, combining static lift and dynamic lift from tilting propeller/rotors and the planform. Cruise speeds in the 150-200 kt (77-103 m/s) will be possible with this configuration with reasonable engine power. The Helipsoid offers at the same time a realistic and practicable solution to the ballast problem, which is inherent in a vehicle generating its lift (fully or partially) from a medium lighter than air. Author

N75-33006 National Aviation Facilities Experimental Center, Atlantic City, NJ
INVESTIGATION OF THE VORTEX WAKE CHARACTERISTICS OF JET TRANSPORTS DURING CLIMBOUT AND TURNING FLIGHT Final Report, Oct - Nov 1973
 Leo J. Garodz and Nelson J. Miller, May 1975, 118 p, refs
 (FAA Proj. 975-430-003)
 (AD-A012383/6, FAA-NA-74-30, FAA-AEQ-75-1) Avail NTIS HC \$5.75 CSCL 20/4

The characteristics of the trailing vortices of several large propeller and jet transport aircraft were investigated. This investigation centered around jet transport vortex persistence and movement during noise abatement-type departure operations at the Los Angeles International Airport and how approaching aircraft could avoid these vortices. It is concluded that the results and conclusions would be applicable to similar operations at other airports. The study is primarily based upon full-scale flight tests of vortex characteristics and their effect on encountering aircraft. Special flight tests for vortex investigations of the B727 during noise abatement climbouts, straightaway and turning flight, in takeoff and clean configuration are included. Vortex-generating aircraft include C5A, B747, B707, B727, DC7, CV880, and Lincoln, vortex probe aircraft included CV990, B737, Learjet 23, DC9, and Devon. A vortex avoidance zone was developed which has an active life of 2 minutes when below 5,000 feet above ground level and 2.6 minutes when higher than 5,000 feet above ground level. Author

N75-33015 Naval Postgraduate School, Monterey, Calif
A RESEARCH STUDY OF THE ROTARY WING TEST AND EVALUATION SEGMENTS AT THE NAVAL AIR TEST CENTER, PATUXENT RIVER, MARYLAND M.S. Thesis
 Bruce Leon Valley, Jun 1975, 105 p, refs
 (AD-A010796) Avail NTIS CSCL 01/3

This study examined the organizational and aircraft maintenance problems of the rotary wing segments within the organizations at the Naval Air Test Center, Patuxent River, Maryland. A static and dynamic analysis was conducted, a model of a consolidated rotary wing organization constructed, and a questionnaire distributed, collected, and evaluated to determine the attitudes of various NATC personnel groups: military and civilian toward pertinent issues. A critical analysis was also conducted of the new NATC mission-oriented directorate organization scheduled for implementation on 1 Apr 1975. GRA

N75-33018 National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety
AIRCRAFT ACCIDENT REPORT TRANS WORLD AIRLINES, INC., BOEING 707-331B, N8734 IN THE IONIAN SEA
 26 Mar 1975, 44 p
 (PB-241705/3, NTSB-AAR-75-7) Avail NTIS HC \$3.75 CSCL 01B

At 0940 Greenwich mean time, September 8, 1974, Trans World Airlines, Inc., Flight 841, crashed into the Ionian Sea about 50 nmi west of Cephalonia, Greece. There were 79 passengers and 9 crewmembers on board; no one survived. The aircraft was destroyed. The National Transportation Safety Board determines that the probable cause of this accident was the detonation of an explosive device within the aft cargo compartment of the aircraft which rendered the aircraft uncontrollable. GRA

N75-33021 National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety
AIRCRAFT ACCIDENT REPORTS BRIEF FORMAT US CIVIL AVIATION ISSUE NUMBER 2 OF 1974 ACCIDENTS
 15 Nov 1974, 560 p
 (PB-242469/5, NTSB-BA-74-6) Avail NTIS HC \$13.00 CSCL 01B

The publication contains selected aircraft accident reports, in brief format, occurring in U.S. civil aviation operations during calendar year 1974. The 896 general aviation accidents represent a random selection. The publication is issued irregularly, normally six times each year. The brief format presents the facts, conditions, circumstances, and probable cause(s) for each accident. Additional statistical information is tabulated by type of accident, phase of operation, kind of flying, injury index, aircraft damage conditions of light pilot certificate, injuries, and causal factors. GRA

N75-33030 Stanford Univ., Calif
WEIGHT OPTIMIZATION UNDER FLUTTER CONSTRAINT Ph.D. Thesis
 Solly Andy Segenreich, 1975, 112 p
 Avail Univ. Microfilms Order No. 75-21897

A new approach to the weight minimization of wings subjected to a flutter speed constraint is the main topic. The use of the flutter speed directly as a constraint is replaced by the vanishing of the damping factor condition. Besides the computational advantages of such an approach, especially in the treatment of compressible aerodynamic models, relatively simple optimality condition equations valid for both incompressible and compressible flows can be easily derived. A second topic is the implementation of a hybrid structural optimization algorithm which attempts to combine the simplicity of the optimality criteria methods with the monotonic weight decrease behavior of the direct descent methods. Encouraging results are presented. Finally, the viability of using assumed modes in static optimization is briefly discussed and one comparative example is given. Dissert. Abstr.

N75-33031* United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
STUDY TO INVESTIGATE DESIGN, FABRICATION AND TEST OF LOW COST CONCEPTS FOR LARGE HYBRID COMPOSITE HELICOPTER FUSELAGE, PHASE 1 Final Report, Aug 1974 - Jun 1975
 K. M. Adams and J. J. Lucas, Jun 1975, 99 p, refs
 (Contract NAS1-13479)
 (NASA-CR-132731, SER-50944) Avail NTIS HC \$4.75 CSCL 01C

The development of a frame/stringer/skin fabrication technique for composite airframe construction was studied as a low cost approach to the manufacture of large helicopter airframe components. A center cabin aluminum airframe section of the Sikorsky CH-53D helicopter was selected for evaluation as a composite structure. The design, as developed, is composed of a woven KEVLAR-49/epoxy skin and graphite/epoxy frames and stringers. To support the selection of this specific design concept, a materials study was conducted to develop and select a cure compatible graphite and KEVLAR-49/epoxy resin system, and a

foam system capable of maintaining shape and integrity under the processing conditions established. The materials selected were, Narmco 5209/Thornel T-300 graphite, Narmco 5209/KEVLAR-49 woven fabric, and Stathane 8747 polyurethane foam. Eight specimens were fabricated, representative of the frame, stringer, and splice joint attachments. Evaluation of the results of analysis and test indicate that design predictions are good to excellent except for some conservatism of the complex frame splice.

Author

N75-33033# Texas A&M Research Foundation, College Station Flight Mechanics Lab
DEVELOPMENT OF STALL DETERRENT CONCEPTS FOR GENERAL AVIATION AIRCRAFT Final Report, Jun. 1974 - Feb. 1975
 H L Chevalier, C R Gallaway, and J R Brown Feb 1975 152 p refs
 (Contract DOT-FA74WA-3516)
 (AD-A012386/9, FAA-RD-75-52) Avail NTIS HC \$6 25 CSCL 01/3

The feasibility of five approaches to develop an airplane stall deterrent device was determined. The static longitudinal stability and control characteristics of a typical light single-engine and twin-engine airplane were obtained and modified with each stall deterrent device. These characteristics were compared to those of an ideal stall deterrent airplane. The five approaches to stall deterrence were the use of a segmented elevator, an auxiliary horizontal tail, a trim tab on the horizontal tail surface, an auxiliary surface to deploy a spoiler on the horizontal tail, and changes in airplane design. The auxiliary horizontal tail was found to make an airplane stall deterrent and in many cases resulted in a stall proof airplane. It was found that the tab was an effective stall deterrent device on the light single-engine airplane. However, the tab stall deterrent device required the use of an angle of attack sensor and servo drive and would be as complex and costly as current stall deterrent devices. Both the auxiliary horizontal tail and the auxiliary surface to deploy a spoiler device have advantages over current stall deterrent devices and potential for further development. A test plan for the development of these devices is given in the report.

Author

N75-33034# Boeing Co., Wichita, Kans
FAAJT3D QUIET NACELLE RETROFIT FEASIBILITY PROGRAM VOLUME 2 UPPER GOAL GROUND TESTING Final Report, Jul. 1971 - Mar 1974
 L L Linscheid, J E Mayer, and H F Veldman Apr 1974 187 p refs
 (Contract DOT-FA71WA-2628)
 (AD-A012969/2, D3-9042-3, FAA-RD-73-131-Vol-2) Avail NTIS HC \$7 00 CSCL 01/3

Model and full scale ground tests were performed on the JT3D quiet nacelle to provide insight and technical background relating to acoustic and propulsion performance of plug nozzles. The information thus obtained was used in the design of the full scale hardware. Full scale engine ground tests were performed on two configurations of the upper goal quiet nacelle to determine its acoustic and propulsion performance.

Author

N75-33035# Loughborough Univ of Technology (England) Dept of Transport Technology
OPTIMISATION OF AEROPLANE UNDERCARRIAGES USING HYBRID COMPUTING FACILITY, PART 1 Final Report, 1 Oct 1972 - 30 Sep 1974
 M R Whitehead Dec 1974 145 p refs 2 Vol
 (Contract MIN-DEF/AT/2170/036/RDT)
 (TT-7414-Pt-1) Avail NTIS HC \$5 75

A hybrid computer technique is described, with which optimization of undercarriage characteristics is attempted in order to create an improved vibration environment in an airframe. The airframe/undercarriage model is represented in two dimensions and includes all the nonlinearities associated with an undercarriage shock absorber. Inputs to the model are provided by measured runway profiles and include aerodynamic influences. A measure of performance is postulated which considers the ride comfort of passengers and crew and stress and fatigue

damage in the airframe. Limitations of the hybrid computing system with respect to automatic optimization are discussed, and alternative methods are considered. It is shown that without the automatic optimization procedure a very simple to use, flexible and efficient design tool remains.

Author (ESA)

N75-33036# Loughborough Univ of Technology (England) Dept of Transport Technology
OPTIMISATION OF AEROPLANE UNDERCARRIAGES USING HYBRID COMPUTING FACILITY, PART 2
 M R Whitehead Dec 1974 269 p 2 Vol
 (TT-7414-Pt-2) Avail NTIS HC \$8 50

Equations of motion are derived for aircraft undercarriage modelling using the method of Lagrange. Maximum scale factors for an analog computer program used for simulating a two-dimensional model are listed together with dimensional data typical of current supersonic transport design. Listings of digital computer programs are presented.

ESA

N75-33042# RAND Corp., Santa Monica, Calif
IDEAS FOR USAF RPV DEVELOPMENT (A TRANSCRIPT OF AN INFORMAL TALK)
 W B Graham Jul 1974 11 p
 (AD-A010979, P-5329) Avail NTIS CSCL 01/3

Suggested is a philosophy of RPV development leading to a plan of action: build some very simple cheap systems, test them and learn from the tests. Then go on to build some other types, extending their range or whatever performance measure seems to be most important based on the tests of the earlier RPVs.

GRA

N75-33043# Ohio State Univ Research Foundation Columbus
DEVELOPMENT OF STALL DETERRENT DEVICE FOR SMALL AIRPLANES Final Report, 26 Jun 1974 - 25 Jan 1975
 Richard D Gilson and Robert W Fenton Jun 1975 64 p refs
 (Contract DOT-FA74WA-3515)
 (AD-A012387/7, RF-3962, FAA-RD-75-53) Avail NTIS HC \$4 25 CSCL 01/4

The effectiveness of a kinesthetic-tactile display as a flight control aid is discussed. Angle of attack information is presented to the pilot, via the display, during critical operational phases, thus, providing a continuous indication of aerodynamic state. It is concluded that the necessary control is achieved with the aid of this display before a stall condition is reached.

Author

N75-33044# Technisch Fysisch Dienst TNO-TH, Delft (Netherlands)
MEASUREMENT OF THE FOCAL DISTANCE OF THE WINDSHIELD OF A NF-5 AIRCRAFT
 E Sies and D VanNoortwijk 18 Dec 1974 12 p
 (TPD-1974-0-5, TDCK-65674) Avail NTIS HC \$3 25

The cockpit windshields of jet fighters are curved in one direction, and act as negative cylinder lenses. Parallax of a gunsight reticle can be avoided by focussing the reticle at the focal distance of the windshield instead of at infinity. The focal distance of the windshield of one NF-5 aircraft was measured, and is 30 to 35m for vertical picture details and definite (zero power) for horizontal picture details. Magnitude of error is calculated. A positive cylinder lens with a focal length of 3m would completely correct position error.

ESA

N75-33045# Naval Postgraduate School, Monterey, Calif
EVALUATION OF AN INTEGRATED ELECTRONIC INSTRUMENT DISPLAY FOR HELICOPTER HOVER OPERATIONS USING A SIX-DEGREE-OF-FREEDOM FIXED-BASE SIMULATION M S Thesis
 Larry Richard Ammerman Mar 1975 96 p refs
 (AD-A010834) Avail NTIS CSCL 01/4

The report discusses the development and evaluation of an integrated electronic instrument display designed to help alleviate pilot work load and improve aircraft control during the precision hover task while flying solely by reference to instruments. The

evaluation uses a hybrid computer system to implement a six-degree-of-freedom fixed-base simulation of the SH-2F helicopter and a graphics processor to generate the integrated instrument display. Evaluation pilots were asked to rate the integrated display against conventional flight instruments after flying a simulated night over-water rescue mission. The evaluation revealed that the simulated aircraft dynamics were susceptible to pilot induced oscillations in a hover and, therefore, unsatisfactory for use as an evaluation tool. In general, the evaluation pilots considered the integrated display preferable to conventional cockpit instruments; however, further study is recommended since meaningful quantitative data were not obtained. GRA

N75-33046# Lockheed Aircraft Corp., Burbank, Calif
COMMERCIAL AIRCRAFT NOISE DEFINITION, L-1011 TRISTAR, VOLUME 1 Final Report, Jun. 1973 - Sep 1974
Nathan Shapiro Sep 1974 86 p refs 5 Vol
(Contract DOT-FA73WA-3300)
(AD-A012371/1, LR-26075-Vol-1, FAA-EQ-74-6-1) Avail
NTIS HC \$4 75 CSCL 01/3

Calculation procedures to describe airplane noise during takeoff and approach were programmed for batch operation on a large digital computer. Three routines are included. The first normalizes far-field noise spectra to reference conditions and then determines spectra at various distances from the airplane, for airport elevations between sea level and 6000 feet, and ambient temperatures between 30 F and 100 F. Overall sound pressure levels, A-weighted noise levels, perceived noise levels, and effective perceived noise levels are calculated. The second routine uses aerodynamic and engine thrust data to produce takeoff and approach flight path description. The basic takeoff is at constant equivalent airspeed, with thrust reduction or acceleration option after gear-up. The approach is along any constant glide slope between 3 and 6 degrees at constant airspeed, with a two-segment option. The last routine combines noise propagation and flight path information to produce constant noise contour footprints. Calculation procedures are presented in detail for airplane noise characteristics, airplane performance, and community noise contours. Author

N75-33047# Lockheed Aircraft Corp., Burbank, Calif
COMMERCIAL AIRCRAFT NOISE DEFINITION; L-1011 TRISTAR VOLUME 2 L-1011-1 DATA Final Report, Jun. 1973 - Sep 1974
Nathan Shapiro Sep 1974 259 p 5 Vol
(Contract DOT-FA73WA-3300)
(AD-A012372/9, LR-26075-Vol-2, FAA-EQ-73-6-2) Avail
NTIS HC \$9 25 CSCL 01/3

The computer program for airplane performance and noise calculations was exercised to generate data in graphical and tabular form. The data and graphs are presented in four sections: noise characteristics including plots of effective perceived noise levels and A-noise levels versus distance at a number of thrust settings; takeoff performance in which the aerodynamic characteristics of the L-1011 were applied to produce takeoff performance data required to define airplane flyover distances for determining noise under the flight path; approach performance includes approach nomographs, and noise footprints includes sets of machine plotted constant noise contours prepared for representative takeoff and approach procedures. For Volume 1, see N75-33046. MJS

N75-33048# Lockheed Aircraft Corp., Burbank, Calif
COMMERCIAL AIRCRAFT NOISE DEFINITION, L-1011 TRISTAR, VOLUME 3: PROGRAM USER'S MANUAL Final Report, Jun 1973 - Sep 1974
Nathan Shapiro Sep 1974 102 p refs 5 Vol
(Contract DOT-FA73WA-3300)
(AD-A012373/7, LR-26075-Vol-3 FAA-EQ-73-6-3) Avail
NTIS HC \$5 25 CSCL 01/3

A description is presented of the logic and the procedures for the noise definition calculations which were developed into a digital-computer program. Sufficient detail is included to permit judgements to be made regarding the applicability of the program

to any particular noise study. For Volume 1, see N75-33046

Author

N75-33049# Lockheed Aircraft Corp., Burbank, Calif
COMMERCIAL AIRCRAFT NOISE DEFINITION, L-1011 TRISTAR VOLUME 4: PROGRAM DESIGN SPECIFICATION Final Report, Jun 1973 - Sep 1974
Nathan Shapiro Sep 1974 127 p 5 Vol
(Contract DOT-FA73WA-3300)
(AD-A012374/5, LR-26075-Vol-4 FAA-EQ-73-6-4) Avail
NTIS HC \$5 75 CSCL 01/3

The input formats and the output options for the noise definition and noise propagation computer programs are given. Test cases are included along with descriptions of plot subroutines and utility subroutines. For Volume 1, see N75-33046. MJS

N75-33050# Lockheed Aircraft Corp., Burbank, Calif
COMMERCIAL AIRCRAFT NOISE DEFINITION, L-1011 TRISTAR, VOLUME 5: COMPUTER PROGRAMMER'S MANUAL Final Report, Jun. 1973 - Sep 1974
Nathan Shapiro Sep 1974 369 p 5 Vol
(Contract DOT-FA73WA-3300)
(AD-A012375/2, LR-26075-Vol-5 FAA-EQ-73-6-5) Avail
NTIS HC \$10 00 CSCL 01/3

A general description of the noise definition and noise propagation computer programs is presented along with description of subprograms and a listing of programs. For Volume 1, see N75-33046. MJS

N75-33051*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
EXPERIMENTAL INVESTIGATION OF A MACH 6 FIXED-GEOMETRY INLET FEATURING A SWEEPED EXTERNAL-INTERNAL COMPRESSION FLOW FIELD
Marvin G Torrence Washington Oct 1975 63 p refs
(NASA-TN-D-7998 L-10046) Avail NTIS HC \$4 25 CSCL 21A

An investigation of a fixed-geometry, swept external-internal compression inlet was conducted at a Mach number of 6.0 and a test-section Reynolds number of 1.55×10^6 to the 7th power per meter. The test conditions were constant for all runs with stagnation pressure and temperature at 20 atmospheres and 500 K, respectively. Tests were made at angles of attack of -5 deg, 0 deg, 3 deg, and 5 deg. Measurements consisted of pitot- and static-pressure surveys in inlet throat, wall static pressures, and surface temperatures. Boundary-layer bleed was provided on the centerbody and on the cowl internal surface. The inlet performance was consistently high over the range of the angle of attack tested, with an overall average total pressure recovery of 78 percent and corresponding adiabatic kinetic-energy efficiency of 99 percent. The inlet throat flow distribution was uniform and the Mach number and pressure level were of the correct magnitude for efficient combustor design. The utilization of a swept compression field to meet the starting requirements of a fixed-geometry inlet produced neither flow instability nor a tendency to unstall. Author

N75-33053*# Kanner (Leo) Associates, Redwood City, Calif
OPTIMUM DESIGN OF A BYPASS ENGINE WITH FLOW MIXING
A Hartmann Washington NASA Oct 1975 26 p refs
Transl into ENGLISH from Wiss Ges fuer Luft- und Raumfahrt and Deut Ges fuer Raketentechnik und Raumfahrtforschung, Jahrestagung (Berlin), 14-18 Sept 1964 p 353-361
(Contract NASw-2790)
(NASA-TT-F-16615) Avail NTIS HC \$3 75 CSCL 21E

The possible advantages of mixing exhaust and bypass flows in a bypass engine are explained. The influences of the pressure ratio of the primary flow, the gas temperature in front of the turbine, the bypass ratio and nacelle drag were calculated on a digital computer and the results are explained. Thrust and efficiency of the bypass engine with mixing are discussed together with the corresponding values of a bypass engine without mixing and the pure turbojet engine. Also considered is the influence of the limited mixing chamber cross section and of partial mixing. Author

N75-33054*# United Technologies Research Center East Hartford Conn

PREDICTION OF EXTERNALLY BLOWN FLAP NOISE AND TURBOMACHINERY STRUT NOISE

Martin R Fink Aug 1975 142 p refs

(Contract NAS3-17863)

(NASA-CR-134883) Avail NTIS HC \$5 75 CSCL 20A

Methods were developed for predicting externally blown flap (EBF) noise and turbomachinery strut noise. Noise radiated by under-the-wing and upper-surface-blowing EBF configurations is calculated as a sum of lift dipole noise, trailing edge noise and jet quadrupole noise. Resulting predictions of amplitudes and spectra generally were in good agreement with data from small-scale models. These data cover a range of exhaust velocity, flap deflection, exhaust nozzle position, exhaust nozzle shape and ratio of exhaust nozzle diameter to wing chord. A semi-empirical method for predicting dipole noise radiation from a strut with incident turbulence was in good agreement with data. Leading-edge regions made of perforated plate backed by a bulk acoustic absorber achieved up to 7 db reduction of strut noise caused by incident turbulence at high frequencies. Radial turbulence in a turbobfan exit duct was found to have a relatively high level associated with the mean velocity defect in the rotor blade wakes. Use of these turbulence spectra and a dipole noise radiation equation gave general prediction of measured aft-radiated sound power caused by a splitter ring in a full-scale fan exit duct. Author

N75-33055*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

DEVELOPMENT OF CIRCUMFERENTIAL SEAL FOR HELICOPTER TRANSMISSIONS RESULTS OF BENCH AND FLIGHT TESTS

Thomas N Strom and Lawrence P Ludwig Sep 1975 20 p refs

(NASA-TM-X-71806 E-8496) Avail NTIS HC \$3 25 CSCL 11A

A modified circumferential segmented ring seal was designed for direct replacement of a helicopter transmission elastomeric lip seal operating on a shaft diameter of 13.91 centimeters (5.481 in.) at sliding velocities to 52.48 m/sec (10 330 ft/min). The modifications involved the garter spring tension shaft roundness seal housing flatness and pumping grooves to inhibit leakage. Operation of the seals in bench tests under simulated helicopter transmission conditions revealed that the seal leakage rate was within acceptable limits and that the wear rate was negligible. The low leakage and wear rates were confirmed in flight tests of 600 and 175 hours (sliding speed, 48.11 m/sec (9470 ft/min)). An additional 200 hours of air worthiness qualification testing (aircraft tie down) demonstrated that the seal can operate at the advanced sliding conditions of 52.48 m/sec (10 330 ft/min). Author

N75-33056*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

INSTALLATION AND AIRSPEED EFFECTS ON JET SHOCK-ASSOCIATED NOISE

U VonGlahn and J Goodykoontz 1975 26 p refs Presented at 90th meeting of the Acoustical Society of America, San Francisco, 4-7 Nov 1975

(NASA-TM-X-71792 E-8469) Avail NTIS HC \$3 75 CSCL 20A

Experimental acoustic data are presented to illustrate, at model scale, the effect of varying the nozzle-wing installation on shock-associated noise statically and with airspeed. The variation in installations included nozzle only, nozzle under-the-wing (with and without flaps deflected), and nozzle over-the-wing (unattached flow). The nozzles used were a conical and a 6-tube mixer nozzle with a cold-flow nozzle pressure ratio of 2.1. A 33-cm diameter free jet was used to simulate airspeed. With the nozzle only, shock wave noise dominated the spectra in the forward quadrant while jet mixing noise dominated in the rearward quadrant. Similar trends were observed when a wing (flaps retracted) was included. Shock noise was attenuated with an over-the-wing configuration and increased with an under-the-wing configuration (due to reflection from the wing surface). With

increasing flap deflection (under-the-wing configuration) the jet-flap interaction noise exceeded the shock noise and became dominant in both quadrants. The free jet results showed that airspeed had no effect on shock noise. The free jet noise data were corrected for convective amplification to approximate flight and comparisons between the various configurations are made. Author

N75-33057*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

COLD-AIR INVESTIGATION OF A 3 1/2-STAGE FAN-DRIVE TURBINE WITH A STAGE LOADING FACTOR OF 4 DESIGNED FOR AN INTEGRAL LIFT ENGINE 1. TURBINE DESIGN AND PERFORMANCE OF FIRST STAGE

Warren J Whitney Harold J Schum, and Frank P Behning Washington Oct 1975 39 p refs

(NASA-TM-X-3289 E-8354) Avail NTIS HC \$3 75 CSCL 21E

The design of the 3 1/2-stage turbine is described, and the cold-air performance of the first stage modified for axial inlet conditions is presented. The performance of the modified single-stage turbine and of two contemporary high-stage-loading-factor turbines is compared with that estimated with a reference prediction method. Author

N75-33058# Environmental Health Lab, McClellan AFB Calif
NOISE SURVEY FOR ADDITION OF T-37 AIRCRAFT AT MATHER AFB, CALIFORNIA Final Report

Ronald D Burnett Marlin L Sweigart, and Harry P Guy Jun 1974 19 p

(EHL Proj M-NBF-348)

(AD-A010037, EHL-M-74M-9) Avail NTIS CSCL 20/1

Noise levels generated by T-37 aircraft were measured at Mather AFB CA while simulating various ground operations and during a flyover. These data were collected to assist in the evaluation of the impact of a proposed T-37 mission on base activities. Noise was recorded inside and outside selected buildings on base which were thought to be affected by these operations. Maximum levels encountered at each building are presented. Measured noise levels indicate little or no impact on base activities from noise generated during operation of T-37 aircraft. Where appropriate, recommendations for minimizing noise and suggestions for additional evaluations are made. GRA

N75-33059# Informatics, Inc., Rockville, Md

INFORMATION OF FAA CERTIFICATION OF AIRCRAFT

Carl Modig Jan 1975 84 p refs

(Contract EPA-68-01-3115)

(PB-242583/3, EPA-550/9-75-022) Avail NTIS HC \$4 75

CSCL 01C

An overview is presented of FAA aircraft type certification regulations and the regulatory process through which aviation noise regulations are or could be implemented. Special reference is made to the regulatory process most relevant to transport category and/or turbine powered aircraft. The various types of certificates are covered. Tabular data for various types and models certificated since 1969 are presented as well as types or models complying with the noise limits in Appendix C of FAR 36. GRA

N75-33060 Virginia Univ Charlottesville

APPLICATION OF ACTIVE CONTROLS TECHNOLOGY TO AIRCRAFT RIDE SOOTHING SYSTEMS Ph D Thesis

Mans Lapins 1975 206 p

Avail Univ Microfilms Order No 75-22169

A critical review of past efforts in the design and testing of ride smoothing and gust alleviation systems is presented. Design tradeoffs involving sensor types, choice of feedback loops, human comfort and aircraft handling-qualities criteria are discussed. Synthesis of a system designed to employ direct-lift and side-force producing surfaces is reported. Two STOL-class aircraft and an executive transport are considered. Theoretically-predicted system performance is compared with hybrid simulation and flight test

data Pilot opinion rating, pilot workload, and passenger comfort rating data for the basic and augmented aircraft are included

Dissert Abstr

N75-33162*# Chrysler Corp, New Orleans La
RESULTS OF A 0.03-SCALE AERODYNAMIC CHARACTERISTICS INVESTIGATION OF BOEING 747 CARRIER (MODEL NO AX 1319 I-1) MATED WITH A SPACE SHUTTLE ORBITER (MODEL 45-0) CONDUCTED IN THE BOEING TRANSONIC WIND TUNNEL (CA5), VOLUME 1

D Sarver, T L Mulkey, and R H Lindahl Aug 1975 795 p
 (Contract NAS9-13247)
 (NASA-CR-141800, DMS-DR-2211-Vol-1) Avail NTIS HC \$15.25 CSCL 22B

The performance stability and control characteristics of various carrier aircraft configurations are presented. Aerodynamic characteristics of the carrier mated with the Orbiter, carrier alone, and Orbiter alone were investigated. Carrier support system tare and interference effects were determined. Six-component force and moment data were recorded for the carrier and Orbiter. Buffet onset characteristics of the carrier vertical tail and horizontal tail were recorded. Angles of attack from -3 deg through 26 deg and angles of sideslip between +12 deg and -12 deg were investigated at Mach numbers from 0.15 through 0.70. Photographs are included.

Author

N75-33163*# Chrysler Corp New Orleans, La Data Management Services

RESULTS OF A 0.03-SCALE AERODYNAMIC CHARACTERISTICS INVESTIGATION OF A BOEING 747 CARRIER (MODEL NO AX 1319 I-1) MATED WITH A SPACE SHUTTLE ORBITER (MODEL 45-0) CONDUCTED IN THE BOEING TRANSONIC WIND TUNNEL (CA5), VOLUME 2 Aerothermodynamic Data Report

D Sarver, T L Mulkey, and R H Lindahl Aug 1975 716 p
 (Contract NAS9-13247)
 (NASA-CR-141803, DMS-DR-2211-Vol-2) Avail NTIS HC \$15.25 CSCL 22B

For abstract see N75-33162

N75-33164*# Chrysler Corp, New Orleans La Data Management Services

RESULTS OF A 0.03-SCALE AERODYNAMIC CHARACTERISTICS INVESTIGATION OF A BOEING 747 CARRIER (MODEL NO AX 1319 I-1) MATED WITH A SPACE SHUTTLE ORBITER (MODEL 45-0) CONDUCTED IN THE BOEING TRANSONIC WIND TUNNEL (CA5) Aerothermodynamic Data Report

D Sarver, T L Mulkey, and R H Lindahl Aug 1975 657 p
 (Contract NAS9-13247)
 (NASA-CR-141804, DMS-DR-2211-Vol-3) Avail NTIS HC \$13.25 CSCL 22B

For abstract, see N75-33162

N75-33183*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

JOINING AND FABRICATION OF METAL-MATRIX COMPOSITE MATERIALS

Dick M Royster, H Ross Wiant (LTV Aerospace Corp) and Thomas T Bales Washington Oct 1975 24 p
 (NASA-TM-X-3282, L-10357) Avail NTIS HC \$3.25 CSCL 11D

Manufacturing technology associated with developing fabrication processes to incorporate metal-matrix composites into flight hardware is studied. The joining of composite to itself and to titanium by innovative brazing, diffusion bonding, and adhesive bonding is examined. The effects of the fabrication processes on the material properties and their influence on the design of YF-12 wing panels are discussed.

Author

N75-33366# Duvvuri Research Associates Chula Vista, Calif
ANALYSIS OF COANDA REATTACHMENT ON CURVED SURFACES Interim Technical Report, 21 May - 21 Dec 1973

Tirumalesa Duvvuri and Joel T Park Apr 1975 52 p refs
 (Contract F33615-73-C-4120 AF Proj 7116)
 (AD-A010620, DRA-TR-73-01, ARL-75-0101 ITR-1) Avail NTIS CSCL 20/4

Current developments in powered-lift STOL aircraft has renewed interest in jet reattachment to adjacent surfaces, the phenomenon also known as the Coanda effect. The experiments and theories on this subject over the past decade have been reviewed. Since reattachment distance on a curved surface has been neither measured nor predicted, an analysis was developed for the prediction of reattachment distance with offset, radius, and ventilation flowrate as parameters. A pair of non-linear equations have been solved on a computer with a minimization technique. Attachment distance as measured along the curved surface increases with offset, ventilation flowrate, and surface radius.

GRA

N75-33998 National Research Council of Canada, Ottawa (Ontario) National Aeronautical Establishment

LIFT c02

W E Laundry *In its Quart* Bull of the Div of Mech Eng and the Natl Aeron Estab 1 Apr - 30 Jun 1975 30 Jun 1975 p 1-10 refs

Using only the three laws of Newton, the phenomenon of aerodynamic lift is explained. Also developed from this approach are the induced drag and the aspect-ratio correction for the lift-curve slope. Finally, it is shown that the explanations requiring airfoil camber and thickness to produce lift are inaccurate and unnecessary.

Author

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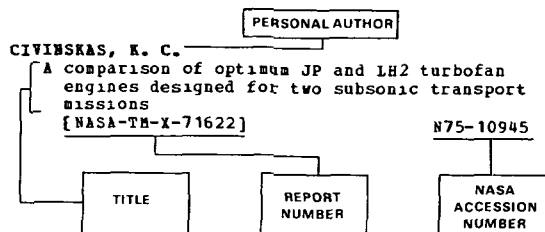
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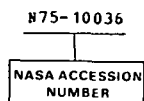
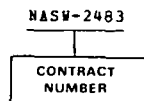
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